THE BRICKBUILDER

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THE ENDURANCE OF STRUCTURAL METAL WORK.

IT is a cause for considerable wonder that iron, which in its various allotropic modifications has been used for so many centuries in connection with building operations, should still, in some of its peculiar qualities, be almost an indeterminate factor. We know that iron rusts. There is abundant visible demonstration that the metal will in time be entirely dissolved by the action of the elements, and yet we continue to build ten and twenty story buildings, depending for their ultimate strength in a great many cases upon the endurance of a few iron rivets. We naturally believe that the iron or the steel as employed in buildings will not be seriously affected by rust, otherwise no sane architect would dare to use the material: but when we consider how little is actually and positively known about the metal, and also consider what the consequence would be in one of the tall sky scrapers if a single joint in some of the lower connections should give way, it becomes of the most extreme importance to architects and constructors generally to gather together all the available experience relating to the subject of the preservation of structural iron or steel. At the recent convention of the American Institute of Architects held in New York, Oct. 16, the subject of the evening's discussion was the very important one of "High Buildings and Good Architecture." A paper was read by Mr. T. M. Clark, of Boston, entitled "Protection Against Fire," which treated of the mechanical question of the construction of such buildings, and broadly assumed that if the steel cage which forms the usual construction of nearly all tall buildings could be protected from fire, the building would be indestructible. The discussion of the evening was concentrated around this particular phase of the paper, and was set in motion by Mr. George B. Post, of New York, by a statement that it was his positive opinion, formed after considerable study of the subject and consultation with the best engineers he could get hold of, that the life of buildings constructed with steel cages would be short. They might last longer than he would, but he believed that there were men listening to him who would live to see the necessity of taking down many of such buildings or else of resorting continually to most radical systems of repair in construction. Mr. Post further stated that, so far as he knew, it was impossible with paint or asphaltum to protect a great system of steel or iron construction so that it would not be assailed by rust. A natural inference is that sooner or later the metal would be so corroded that it would cease to be safe.

This is by no means a new difficulty. The question has probably been raised with every large building which has been erected within the last twelve or fifteen years, and it has caused a great deal of sleepless thought on the part of architects and owners before either could feel justified in adopting a material which so palpably appears to be short-lived. One of the things that foreigners urge most strongly against our system of architecture of to-day is the fact that we build tall buildings depending, not upon inert masses of masonry, but upon the strength of metal connections which are sure to rust. Mr. Post cited the case of some iron beams which he removed from the ceiling of the old pressroom of the New York *Times* building a few years ago. These had been for thirty-five years encased in brickwork, being connected by eight-inch arches levelled up over the haunches with concrete. They had been subjected on one side to occasional small quantities of live steam, and when taken out very many of them were entirely destroyed by rust so they could be broken between the fingers. Mr. Post cited another instance of a water tank that had been in use for twenty years, the inside five-eighths-inch iron rods of which he found had rusted completely away. He objected not so much to a possible construction of iron work made with the greatest possible care, but rather to such construction as he had seen going up in the city of New York during the past few years, where the iron columns were given a very light coat of paint and very little attempt made to protect the joints. He presumed that the great mass of joints would remain for a considerable period perfectly sound and safe, but with several hundred bearing joints in a building, put up without any very special care, with a great deal of recklessness in many cases, with no protection except eight inches of ordinary brickwork, he did not believe such buildings would stand for any great time with perfect safety, but that the construction of many of them would last no longer than did the beams he took out of the *Times* building. He stated that he never had dared to use a cage enclosed in masonry as the construction of a building; but he had built the cage detached inside, anchoring the walls to it, so the metal could be examined at the joints, and, in case of corrosion, painted or repaired.

It is well known that cast iron will corrode much less rapidly than wrought iron, and Mr. Post accordingly suggested that a cage construction of cast-iron columns incorporated in the walls, with cast-iron girders locked to the columns by a mechanical joint, without steel or iron rivets or bolts, would make a cage construction which would be reasonably free for a long period from the dangerous effects of corrosion. With cast iron the danger from corrosion would be slight. When it rusts it does not split off in laminæ, but forms on the surface a fine coating of oxide of iron, which, under the action of water, becomes a sort of paint which protects the iron from the further action of rust. Mr. Post did not explain, by the way, why exactly the same change and corresponding protection would not also occur with wrought iron and steel; but even if it should occur, it is evident that such protection would be much less efficacious with wrought iron than with cast, as is proved by the case of the water tank previously cited, in which, though the wrought-iron rods had rusted entirely away, the cast-iron plates forming the sides were hardly affected at all.

Mr. R. H. Robertson also took up the same theme in the discus-

sion, agreeing in the main with Mr. Post, that without great care in the protection of steel-constructed buildings their life would certainly be limited, advising that mere brickwork is not sufficient protection against the infiltration of water and consequent corrosion, but that all external walls protecting iron work should be thoroughly and periodically painted.

Criticism such as the foregoing, when put forward by architects of such high standing as Mr. Post and Mr. Robertson, could not fail to call forth a very animated discussion, especially when addressed to a body including so many architects who had used steel construction to such great extent. Mr. W. L. B. Jenney agreed with all that Mr. Post had said as to their being numerous instances where steel and iron had perished under certain conditions. On the other hand, there is in Chicago to-day a piece of steel which was dug out of old Rome, which is certainly five hundred years old. When the obelisk now in Central Park was moved from Egypt there was found underneath it a piece of iron that dates back perhaps a thousand years. In India there is a column made of lumps of wrought iron, extending about twenty feet into the ground, that has stood there from eight hundred to a thousand years. There are, therefore, plenty of examples of long-enduring, well-behaved steel, as well as of steel that has behaved badly. A number of years ago Mr. Jenney was in Paris at the time of the tearing down of some of the old buildings to make way for modern improvements, and he took particular pains to notice the fine condition of the iron bars which were taken from some of the old buildings where they had been in position hundreds of years without in a single instance evincing any evidence of any more corrosion than would take place in the first week or two while the building was under construction.

Prof. W. H. Burr admitted that it was generally held that cast iron would resist corrosion much better than wrought iron, though he doubted whether the comparison was true as regards steel. He had tested it by imbedding plates of cast and wrought iron in the ground for a period of two years, digging them up from time to time at intervals of several months to observe which had corroded most. At the end of two years he was unable to detect any difference. He cited the case of a railroad bridge near Norfolk, Va., which was supported by cast-iron columns and braced by wrought-iron rods, both columns and rods being partially submerged in salt-water. This construction had existed for about thirty years, and the iron had withstood the action of the elements very satisfactorily. When the bridge was removed, he examined the iron work and found no worse corrosion than a thick coating of rust upon the cast columns, and a somewhat thicker coating upon the wrought-iron rods, but still they had the larger part of their sections intact as good iron. He had also inspected some wrought-iron Phœnix columns which had stood for about twenty-two years as the supports of the platform which held a blast furnace, and had been, during that time, subjected to the action of steam from the water thrown upon the molten metal as it ran from the furnace, being alternately wet and dry, and exposed to the atmosphere under conditions which would be as trying as any which could be imagined. The columns during that period, apparently, had not been painted at all, but he found on the surface of the metal nothing more than a thin coating of rust, perhaps as thick as a thin sheet of paper. The ends of the columns which abutted against castings at top and bottom were rusted to some extent, though not enough to appreciably impair their strength, and the columns could apparently have stood forty or fifty years longer in that exposed condition before any apprehension would need to be felt as to their endurance. Judging from his experience, Prof. Burr could see no ground for naming any definite life for structural steel or iron work. In fact, its endurance, as far as experience goes at the present time, could be considered practically indefinite. The fact could not be questioned, that in some situations corrosion would take place, and take place rapidly, that he had seen for himself, but it was under circumstances which could be easily prevented, and required no more care in the design or in the construction than that which should always be given to other details.

Mr. D. H. Burnham also quoted from his personal experience. A number of years ago when it was proposed to use iron rails for the foundation of a large building, a distinguished civil engineer was asked to make an investigation and give a written opinion. He took some little time, and finally filed his results, among other things citing the fact that he had found during his investigation pieces of steel and wrought iron dug out of Pompeii where they had been imbedded in cement or mortar, showing only a slight scale on the surface, due to oxidation when the pieces were taken out. He had also seen pieces of wrought iron taken from bridge abutments which were forty years old and were apparently in perfectly good condition. And the sum of his recommendation was that it was perfectly safe to use wrought iron in the foundations if it was well covered with cement. Mr. Burnham stated that about ten years after the iron was so used the foundation was uncovered and the metal investigated, when it was found there was a slight scale of oxidation only, probably due to the air which was in the cement close to the iron. He cited, however, the case of the ceiling beams over the engine-room of the Rookery Building, which are under the side alley and are exposed to unusual conditions which would never exist in the cage construction. These beams were taken out a couple of years ago in a bad state of corrosion. Mr. Burnham added that he had repeatedly examined uprights and floor beams with a view to ascertaining whether they were corroded, and where they had been well painted he had never found in any case even the first sign of scaling on the surface. These investigations had only covered a period of four or five years, but he believed the iron or steel would show no more corrosion in ten years than it would in one.

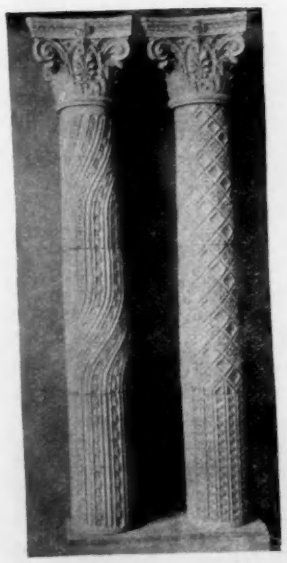
In regard to the substitution of cast iron for steel, while admitting the fact that the former material is less liable to rust, all of the speakers except Mr. Post seemed to be unanimous in a strong distrust in the material itself, due to the difficulty of inspection and the treacherous nature of many castings. Mr. Burr claimed that the experience of engineers with structural materials had led them for the past twelve or fifteen years to exclude cast iron from structural design, except in some special cases where it could be used in large blocks, so that its treacherous qualities would do no harm if they should be developed. Indeed, except in connection with railroad bridge work, which must have wall plates built directly into the masonry to hold the bridge structure, civil engineers will not allow cast iron in their operations, and Prof. Burr stated that it was a matter of great surprise to him and to many of his engineering friends that architects should be willing to use the metal so generously throughout buildings in such members as columns. As showing the liability of cast iron to crack, he cited an instance of some cast-iron weir boxes which were put in place as satisfactory specimens, but after a period of five or six days a crack commenced in one of them, and before that crack had completed its work it had passed entirely across one box, its mate following precisely the same example within a week. He had also seen cast-iron bases, such as were designed and had been used by the hundreds in the elevated railroads of New York and Brooklyn, explode with the noise of a pistol while standing on the platform awaiting shipment, — not in one case alone, but in a number, — and he had also seen them crack after they had been placed. Mr. Jenney said he had very largely abandoned the use of cast iron, owing to some very troublesome experience he had had with air bubbles and honeycombed spots in the castings, which showed no visible signs of their existence and were often almost impossible to detect by even the closest investigation. Mr. Burnham instanced two cases which had decided his practice in regard to cast iron. The first was a heavy cast-iron column for the first story of a tall building, which seemed to be all right, but something caused him to feel that everything was not as it should be, and a workman with a point and a striking hammer was sent to test the surface. He found that the column was honeycombed for three quarters the distance around it, and at least three feet high, so that for at least half of the periphery there was not remaining more than a quarter of the metal area. Its honeycombed spots had been filled with white metal and had been painted over very carefully. At another building a column about ten feet long,

two feet in diameter, and with two-inch metal, fell to the street and broke while handling in the delivery wagon, revealing an air chamber three quarters the distance around it and at least two feet long, which was absolutely concealed inside, so that it was doubtful if any one not having an extremely delicate ear could have detected the flaw. Mr. Burnham said that since that time he has never used a cast-iron column, because of the impossibility of making a proper inspection which would discover the air chambers inside the casting. Besides this there is of course the added difficulty of getting a true casting, or one in which the core retains its original position. It is seldom that a perfect cast-iron column is set up. Wrought columns, on the other hand, can be inspected in every joint and every detail,— all of the metal is accessible from the exterior, and there is very little opportunity for any of the hidden defects which make cast iron so unreliable.

In conclusion, the discussion, animated and complete as it was, really decided very little except as matters of experience. We know that iron and steel will rust under some conditions. Fortunately we may also assume, on the evidence of the gentlemen quoted above, that the liability of dangerous corrosion is very slight if the metal is properly protected. One of the tallest buildings in New York is constructed with cast-iron columns in the lower portion and wrought steel above, but the architect informed the writer that his experience would not lead him to use cast iron another time. Theoretically, cast iron is preferable. Practically, on account of its joints, the difficulty of making proper connections and the liability to break from a sudden shock, to say nothing of the impossibility of getting absolutely true castings, it seems generally to be discarded. It must be remembered in considering any question of this sort that the quality of steel has improved a great deal within the last few years, so that to-day the architect can depend upon the quality of the material he receives as being reasonably pure and homogeneous, whereas in the early stages of their manufacture steel beams would often break even more treacherously than cast-iron columns. Wrought iron is supposed to be the pure metal. Steel contains a small proportion and cast iron a larger proportion of carbon. Whether the presence of the carbon in the metal acts as a retardant of the corrosion it is impossible at this time to state; but however steel may fail in some cases, there certainly seems to have been adduced unquestioned testimony to the life of the material as ordinarily used in building construction.

C. H. BLACKALL.

[The foregoing article covers a subject inseparable from modern fireproofing. Its natural place is in the department on "Fireproofing," but lack of space there and the importance of the paper lead us to publish it as the leading article for this month. — ED.]



ONE of the special features of the American Theatre in New York City is the roof garden, which is treated in a very pleasing manner with considerable rich detail in terra-cotta. The two columns here given are used in this part of the theatre. They are the work of the New York Architectural Terra-Cotta Co., who have furnished us with several other details from this building, some of which were published last month, and others will be found elsewhere in this issue, and in the December number. The architect is Mr. Charles C. Haight, of New York City.

ARRANGEMENTS are now being made with an architect about to spend the winter in Italy, by which we expect to secure for publication next year a series of twelve plates of measured drawings of brick details that have never been published.

BRICK AND MARBLE IN THE MIDDLE AGES.

CHAPTER VII. — CONTINUED.

G. EDMUND STREET.

"And whither journeying? To the holy shrine
Of Saint Antonio in the city of Padua."
Rogers.

NEIGHBORHOOD OF VERONA — VICENZA: CATHEDRAL — SAN LORENZO — SANTA CORONA — PALAZZO DELLE RAGIONE — GOTHIC PALACES — PALLADIO'S WORKS — TEATRO OLYMPICO.

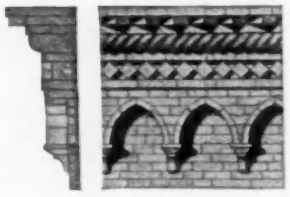
MANY of the villages near Verona are remarkable for the remains of castles of the Middle Ages. I have never, however, been able to find time for the examination of any of them, and, judging from hurried views which I have had of three or four castles south of Verona, I suspect that they would scarcely repay a long *détour;* they seem generally to be more remarkable for their general contour, and their quaint forked battlements, than for any of that delicate detail and appliance to ordinary wants which it was especially my object to see and study.

The railroad from Verona to Vicenza and Padua is not interesting; the country is beautiful and luxuriant in detail, but rather tame, flat, and over-green in the general view. The Veronese mountains, however, are in view on the north, and as one approaches Vicenza the hills throw out their spurs into the flat country, covered with vineyards, orchards, and fruit trees; village follows close upon village, each with its white church and white campanile, contrasting strangely with the rich color above and around, and at last the towers and roofs of Vicenza are descried on our left.

And is it possible, my readers will exclaim, that you, an architect, can have dared to pass within sight of Vicenza without making long sojourn there to drink in the lessons which the works of your great master Palladio are there to instil! Even so, reader; for in this world there are unhappily two views of art, two schools of artists, — armies of men fighting against each other; the one numerous, working with the traditions and rules of their masters in the art, exclusive in their views, narrow in their practice, and conventional in all their proceedings, to the most painful forgetfulness of reality either in construction or in ornament; the other young and earnest, fighting for truth, small in numbers, disciples of nature, revivers of an art to all appearance but now all but defunct, yet already rising gloriously above the traditional rules of three centuries. The one class representing no new idea, breathing no new thought, faithful to no religious rule; the other rapidly endeavoring to strike out paths for themselves as yet untrodden, gathering thoughts from nature, life from an intense desire for reality and practical character, faithful moreover to a religious belief, whose propagation will be forever the great touchstone of their work. The one class, the disciples of Palladio, journeying toward Vicenza with a show of reverence to learn how he built palaces of compo with cornices of lath and plaster, already in two short centuries falling to decay, wretched and ruinous! the other stopping long at Verona, dreaming over the everlasting art of the monuments of the Scaligers, and of the nave of Sta. Anastasia, still, though five centuries have passed with all their storms about their heads, fresh and beautiful as ever, fit objects of veneration for the artist in all ages.

A disciple, therefore, of the last of these two schools, I stayed not longer at Vicenza than was necessary to satisfy myself of the truth of the charges against Palladio's work there, and to note the few, but interesting, mediæval remains. The situation of the city is beautiful. Near it to the north are mountain ranges, and where these descend into the plains there are smaller hills covered everywhere with luxurious vegetation. The first view of it is also very fine. In

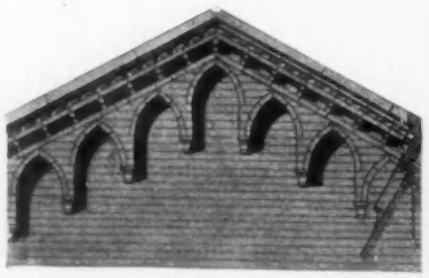
front is the old brick tower at the Porta di Castello, with its deep brick machicoulis sloping boldly outwards, and finished with a square battlement under a flat roof. Beyond this are seen the steeples of the city, and highest among them the Torre dell' Orologio, a tall, slender brick tower in the Piazza dei Signori, in the centre of the town. The most important Gothic churches are the Cathedral, San Lorenzo, and Santa Corona. They seem all to be in very much the same style — one derived no doubt from Venice, as we shall see when we arrive there. The plans usually are of this kind. The bays of the nave are square in plan, those of the aisles oblong in the direction of the length of the church, the choirs apsidal, and the chapels on each side of them also apsidal, but with an equal number of sides, so that there is an angle in the centre. The transepts are square ended, the sacristy at the end of one of them, and the tower at the side of the chancel aisles. The Cathedral departs from the type of plan just mentioned, but is, I think, the only exception to the rule. It has a very wide nave without aisles some fifty-five or sixty feet in the clear, but it has been so much repaired and altered that it is now very uninteresting. Good effect is obtained by the very great elevation of the altar, which is raised above a crypt, the entrance to which is by flights of steps on each side of the steps which lead up to the choir. The exterior is mainly of brick save at the west end, which has an arcade of stone with a doorway in the centre division.



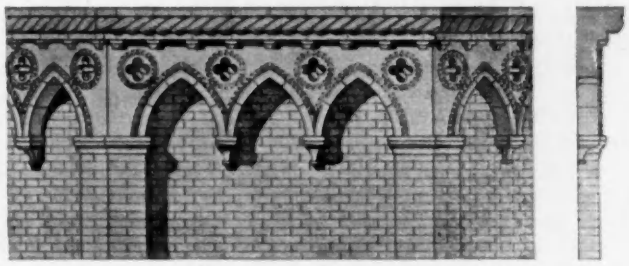
This kind of west front is repeated in the more interesting church of San Lorenzo, which is finished with one vast gable in front of nave and aisles, and has for its lower stage an arcade of seven divisions, with a fine pointed doorway occupying the three central arches. This part of the front is mainly of stone, with enriched members around the arches in brick, and it is divided from the upper stage by a corbel-table. The gable is of brick with a large stone circular window in the centre, and five smaller circular windows following the line of the flat gable which crowns the whole. I was not much impressed by this design, the only virtue of which is a certain amount of simplicity and breadth.

The interior of San Lorenzo is lofty and spacious. The nave and aisles alone measure about one hundred and fifty feet by ninety, and there are spacious transepts, choir, and chapels. The columns are circular, and have capitals so badly carved that it is somewhat difficult to say whether they have shells or tufts of foliage for enrichment. Very small circular windows in the clerestory, and a groined roof, complete the design. The best portion of the exterior is, I think, the elevation of the bays of the nave aisles. Here there are two simple trefoiled lancets with a shallow buttress between them, and a circular window above in each bay. This design is refreshingly pure and simple. The steeple is on the east side of the north transept. It is of six stages in height, the stages being marked by slightly sunk panels, and corbel-tables under stringcourses, which are formed by a pattern in the bricks, not by any projecting moulding, so that the straight outline of the steeple is not broken. The result is not particularly good.

Santa Corona has, like the other churches, a single gable in front of the nave and aisles, with a western doorway and a large circular window above. I have a recollection of it as of one of the most ungainly of fronts. The campanile here is much like that of San Lorenzo, but has a low octagonal belfry-stage finished with a small circular brick spire.

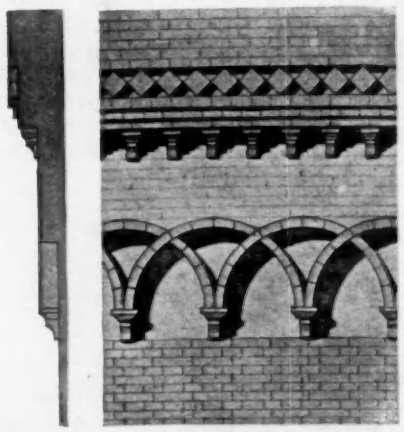


Santa Corona may well be more visited for a picture by John Bellini than for its own merits. This is a picture over one of the altars in the north aisle representing the baptism of our Lord, — one so quiet and beautiful in color, so dignified and solemn in its design, that it is impossible to admire it too much. Behind the group of



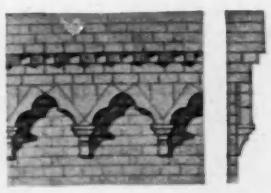
angels who hold our Lord's garments is a mountain landscape such as one sees from Vicenza. It is a sublime work. The marble reredos is coeval with the picture: it is furnished with two low screen walls right and left of the altar, a common and proper arrangement for its protection when, as here, the altar stands in the aisle itself and not in a chapel.

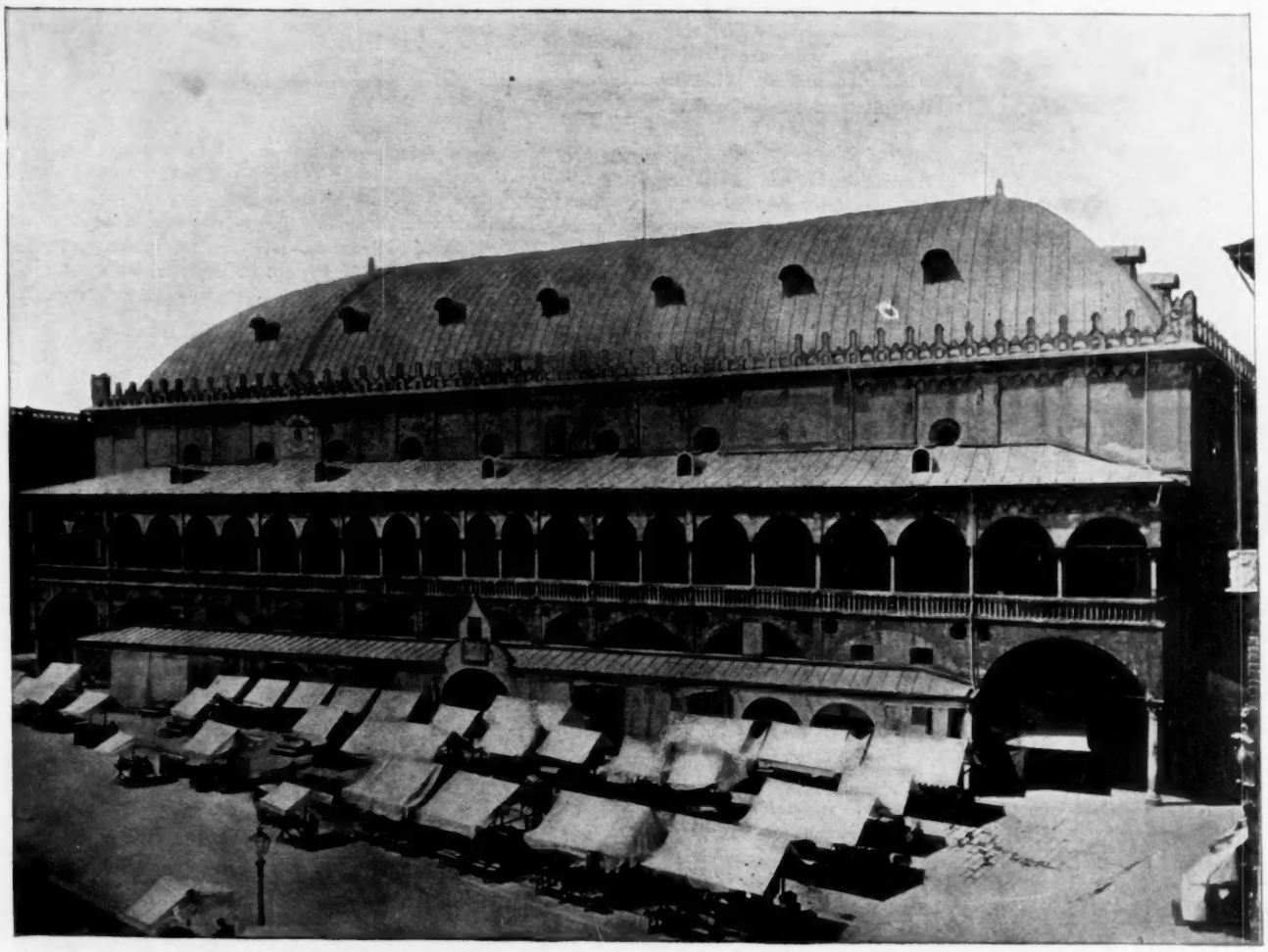
I did not find any other church worth noticing, and soon made my way to the Palazzo delle Ragione. The great feature of this building is the enormous hall, no less than seventy-two feet wide inside, and covered with a great arched timber roof boarded on the under side, and divided into vertical panels by bold ribs painted black and white. This roof is held together by two tiers of iron ties, and, being arched and boarded at the end as well as at the sides, has somewhat the look of the inverted hull of a great ship. The effect is imposing, though at the same time it is somewhat gloomy, owing to the absence of all high light.



This great hall was Gothic inside and out until Palladio cased the front with open arcades, standing out from the walls and entirely concealing from below the old windows. These were large single lights with moulded jambs, but not of very good style. The original staircase remains, with good marble shafted balustrades. The old work here is said to have been done before the year 1444, the hall having been burnt in 1389. This date is of some importance, as the walls of the upper portion are faced like the upper stage of the Ducal Palace at Venice, — with marble arrangement in a diaper.

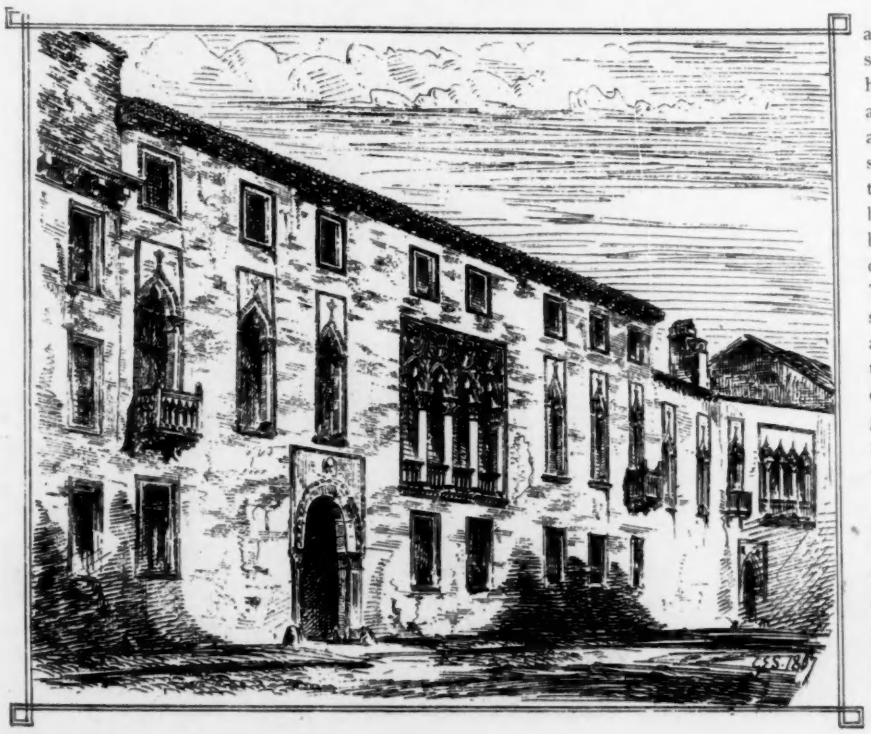
The slender and lofty tower of brick which rises at one end of the building, the two Venetian columns (Vicenza became subject to Venice in 1404), and the Palazzo itself, in spite of its small architectural merit, combine to make a charming picture, rendered more beautiful, when I saw it, by the animated crowd of peasants who filled the piazza. The streets here are very picturesque, rather in spite of Palladio and Scamozzi than in consequence of what they did. Some of them are arcaded, and the Gothic houses are still very numerous. They are all, however, of late date — at least I saw none earlier than





PALAZZO DELLE RAGIONE, PADUA, ITALY.

SUPPLEMENTARY ILLUSTRATION TO "BRICK AND MARBLE IN THE MIDDLE AGES."



about 1350. They are of the same design as some of the well-known Venetian palaces, only here they rise out of narrow streets, instead of, as they do there, from the water. The usual arrangement is to have on the ground floor a single doorway, not necessarily central, and on the piano nobile a fine traceried window with balconies in the centre, single windows also with balconies near the angles, and intermediate windows of the same design but without balconies. These are always treated in the same way with small shafts, and with animals seated on their angles, and are supported on bold corbels. All the carving that I saw was weak and confused in outline, and poor in detail, and the capitals are generally too large for the arch mouldings which rest on them — a common fault in Italian Gothic work.

I give a view in the Contrada Porto, which illustrates two of the best of these houses. Almost the whole of this street happens to consist of houses of the same age, and one of them has on one side of its internal courtyard open arcades on each story, the upper one having its balustrades remaining between the columns, similar in design to those in window balconies.

In their original state most of these houses

seem to have been left in red brick, the windows being of stone, with thin white marble slabs fitted into the spandrels above the arches. Projecting balls of marble are often fixed in front of this marble lining. Some houses seem, however, to have been plastered almost from the first with a view to painting, and I can hardly say a word against such a plan, with the recollection of the glowing — in spite of their being faded — tints which one still sees at Brescia, Genoa, and elsewhere in Italy. But where the house has architectural features which are at all good of their kind, the painter is very apt to ignore them entirely in his work, so that what was meant to be a good piece of architectural work becomes in the end a badly cut-up ground for a painting. Where there is no architectural detail to be spoilt, any amount of painting may be lavished on an external wall; and I know few examples which better show with how much good effect it may be done than the great house of the Fugger family, in Augsburg, which many Italian tourists nowadays may see and admire on their way to or from Italy. The other objection to external painting is its evanescent character; but good color is beautiful even in its decay, and I suppose the best artist will paint what will do most good to his own generation, and trust to his successors for doing as much for their own times!

One of the most fanciful houses in Vicenza is the Casa Rigafetta, below the Palazzo Pubblico. The ornaments are not pure, and there is too much straining to make the most of an opportunity by putting everything possible into a small space, but still the whole is decidedly pretty. The balconies here are in plan half a quatrefoil. Near this house is one with carved angle-shafts, a feature which I do not remember to have seen in Venice.

Palladio's works are supposed now to be the glory of Vicenza. I cannot forgive the artist who did not care to give solidity to his work, and the power of executing a vast amount of enrichment in the cheapest way, and with the commonest materials, is about the greatest snare into which an architect can allow himself to fall. I am well aware that Palladio was not the inventor of trumpery modes of construction. His admirers might quote the architects of Pompeii. fifteen hundred years before him, as offenders in the same way, and the curious preservation of their works as the justification of their offence; but Palladio followed after men of his own kind and craft who for centuries had studiously endeavored to do their work honestly, and he deserves, therefore, all the hostile criticism of those who object to a revival of bad practices which in our own day and country have done more real damage to architecture than anything else that can be named.

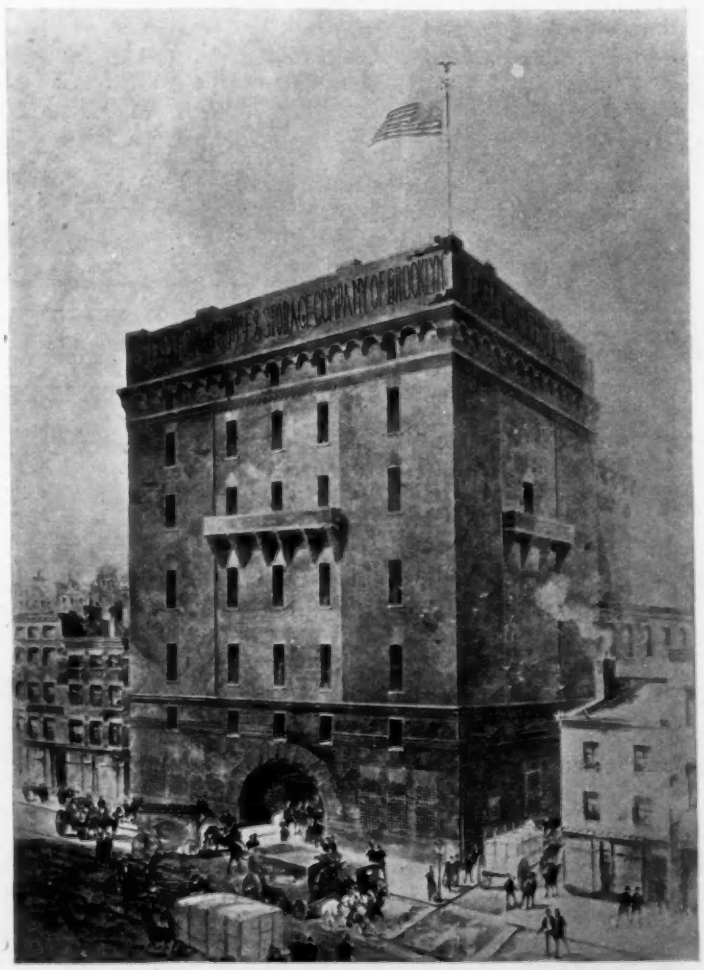
One only of Palladio's works interested me, and this rather as a curious experiment than as a work of art. This is the Teatro Olympico, a famous open-air theatre. There is, first of all, a semicircular auditorium open to the sky, and only remarkable for a mean arrangement of pilasters at the back. The great object of interest is the stage, on which a permanent scene has been constructed by Palladio. In order to make this look much larger than it really is, the streets, palaces, and temples which are represented are built in perspective. To accomplish this the stage rises very rapidly, the buildings are squeezed up and built in sharp perspective, so that in the end a triumphal arch, which is really forty feet from the front, looks as if it were four hundred. Should an actor, by any chance, so far forget himself as to walk into what looks like a practicable street, in a minute he would find himself able to shake hands with the statue on the top of the arch, the illusion would be entirely destroyed, and the scenery would all look like a collection of dolls' houses. As an ingenious deception from one point of view, and under certain conditions, the scheme is successful, and probably this is as much as Palladio himself would have claimed for it.

We had now seen all that we cared to see in Vicenza, and gladly found ourselves again *en route*. There was nothing to see on the road, and we were not sorry when our engine gave token by its whistle of our approach to Padua. The omnibus discharged us in a few minutes at the hospitable doors of the Stella d'Oro, and we were soon out again, with the view of making the most of our time.

(*To be continued.*)

[For supplementary illustrations to the foregoing article this month we have taken five details from Prof. Heinrich Strach's admirable work on the brick and terra-cotta of Italy. Every architect should possess this valuable book. It is published in Berlin, at 100 marks. We will secure copies and deliver them to any address in the United States, express paid, for $33.00. For particulars as to contents and scope of the work addess the editor of THE BRICKBUILDER.]

THE rise of Messrs. Fredenburg & Lounsbury to a position of prominence in the New York material market has been as rapid as it is deserved. By constant application to business on business principles, this young concern has taken its place among the leading brick manufacturers' agents in the New York district. Foremost to recognize their ability was Mr. H. E. Mack, general manager of the Eastern Hydraulic-Press Brick Company, and, as a result, Messrs. Fredenburg & Lounsbury have been installed in the offices of this company, Metropolitan Building, New York, as selling agents for New York and the New England States.



EAGLE STORAGE WAREHOUSE, FULTON STREET, BROOKLYN.

FRANK FREEMAN, Architect. P. J. CARLIN & Co., Builders.

Laid up in Clinton Hematite Red Mortar Color, made by the Clinton Metallic Paint Co., Clinton, N. Y.

THE ART OF BUILDING
AMONG THE ROMANS.

Translated from the French of Auguste Choisy by

ARTHUR J. DILLON.

CHAPTER II. — CONTINUED.

I.

VAULTS WITH ARMATURES WITH RADIATING JOINTS.

One can understand that the brick armature of the Palatine (Plate I.) would serve as a centre during the construction of the vault, for it is a continuous network withstanding a constant force; nothing is simpler. Even in the aqueduct of Nero, where the arches are quite close to each other, and where the large square bricks nearly span the intervening space, it can be seen that the brick skeleton is capable of carrying the greater part of the weight of the rubble while the vault is in course of construction. But, it may be asked, is it the same when the armature is reduced to a system of engaged double arches, to a series of rings, not only distinct from each other, but also separated by a distance of almost three metres? Does it not seem that the arches will hold up only the rubble directly over them, and that the still semi-fluid mass between each arch and the next one will bear directly on the covering of the wooden centring? Such is the difficulty, but the following, I believe, is the solution.

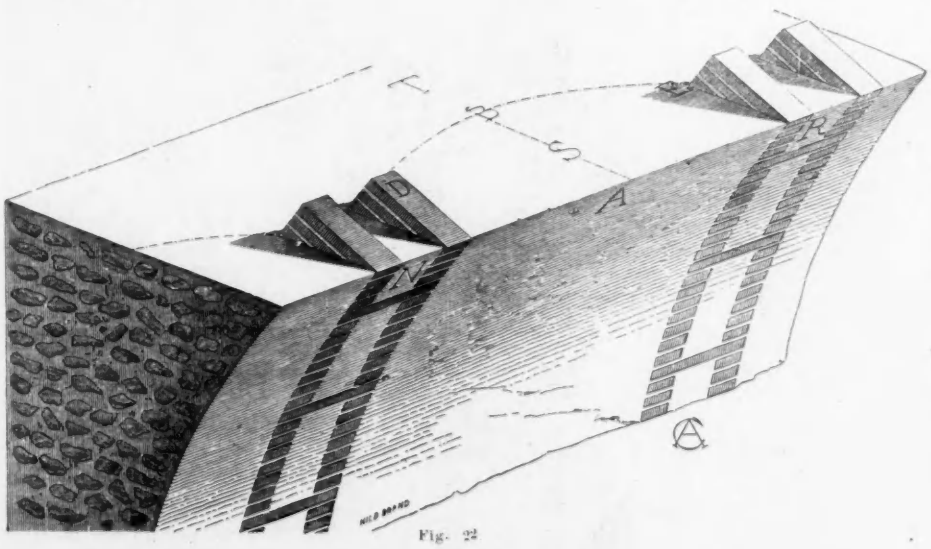


Fig. 22

Let us take (Fig. 22) a vault built on ribs cut by a horizontal plane, or, in other terms, such a vault interrupted in the course of construction, and let D and E be the sustaining ribs. It is evident that the two ribs would suffice to support the mass of the vault, whatever the interval between them, if the horizontal courses of this mass were bounded not by the right line N A R, but by the curve D B E, and this would be true no matter how irregular were the rough fragments composing the horizontal courses, if the curves, such as D B E, were given a sufficient crowning A B. Thus each course of the rubble can be imagined as being composed of two parts, of which one, lying outside of a certain imaginary curve, D B E, will sustain itself as though it were a sort of horizontal arch with radiating joints abutting on the ribs D and E. The other part S comprised between the curve D B E and the intrados will be suspended from the first portion, stuck to it, as it were, by that commencement of adherence which mortar has at the instant it is laid.

This explanation does away with the objections that might be raised against the use of the discontinuous armatures, and at the same time explains the slightness and irregularity of the pieces of wood which the Romans used for the lattice of the centring, even when the brick ribs were very widely spaced. These pieces, whose form is shown by the imprints they left, were long thin boards, ordinarily with many flaws, and placed in a haphazard way on the principals of the centring. Their *rôle* was not so much to sustain the rubble as to form a mould for it; at the most they had to sustain, and only until the mortar set, the insignificant weight of that part of the whole mass marked "S" in the preceding figure. The same system of insolated ribs is to be found on a larger scale in the Basilica of Constantine. We have been considering vaults over galleries of perhaps five metres in breadth, but here the vaults have a diameter of more than twenty-three metres, which is almost the width of the nave of St. Peter's at Rome.

Vaults of such a size require supports of exceptional strength, and the architect, fearing no doubt that single arches such as those of the Coliseum would be insufficient, reinforced them with similar ones, so that the support is composed of two interlocking arches of brick one over the other (Plate III. and Fig. 24). This manner of doubling the armature in order to make its strength proportionate to the span of the vault seems quite natural, but it might be questioned whether it would not have been preferable in place of superimposing the arches than to have placed them side by side, taking the precautions to securely tie them together. This would have more completely reverted the intrados of the vault and at the same time increased the base and stability of the ribs without requiring a greater number of bricks; but this arrangement, immaterial in regard to the number of bricks, was quite the contrary in regard to the expense of the temporary centring. When the two arches interlocked and were superimposed, as in the Basilica of Constantine, only the first needed to be supported on centres; once in place, the first arch served as the centring for the second one which surrounded it; if, on the other hand, the two arches had been built side by side instead of superimposed, they would have borne on the centres at the same time and, as they would be practically of the same weight, the strength of the temporary work would have to be doubled. Hence, considering economy of temporary work, it was more advantageous to do as the Romans did, and strengthen the rib by placing the second arch over the first.

But it still remains to be seen whether the economy in the temporary work was not partly balanced by the risks of buckling.

It is certain that an arch twenty-three metres in diameter and but sixty centimetres between the faces could not have its centring removed without buckling and falling in ruins. But the strength to be given to the armature of a rubble vault is not to be calculated under the condition that it is to support itself and an additional load the moment it is completed, for its strength at this moment is of little importance provided that at the instant the rubble commences to weigh upon it, it can withstand the compressive forces and the causes of buckling. Regarding the question in this light, which is the only true one, it is evident that an arch of only sixty centimetres from face to face is amply sufficient; for in the first place, during the entire period when the mass of the vault does not bear on the centres, the armature is clearly in no danger, braced as it is by the wood intended for the moulds of the octagonal cushions (Plate III., Fig 25), and secondly, when the pressure does commence to come into play it

does so progressively, increasing at first quite slowly, and at a greater rate as the mass approaches the summit. When the pressure commences to be felt the real span (A B, Fig. 23) of the arch is already

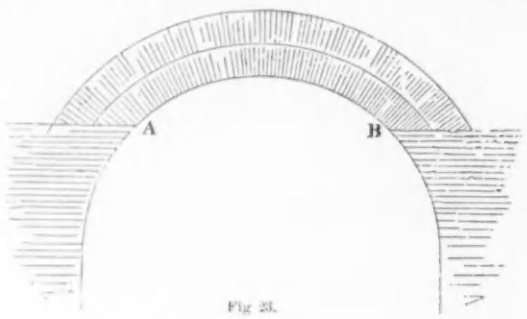


Fig 23.

much smaller than the diameter of the barrel vault, and as the rubble is laid the real span of the arch is continually reduced to the portion not buried in the mass. Thus it can be seen that the resistance of the armature increases with the forces it has to withstand; and when the still wet mass of rubble reaches such proportions that its weight upon the ribs becomes considerable, the span of the arch is so much reduced that it is quite capable of resisting the pressure. In a word, the solidity of the ribs and their resistance to buckling tendencies increases as the opening A B decreases, that is, as strength is more necessary. We can thus understand how it was possible to use such thin arches as supports in building one of the most colossal vaults that the ancients ever raised; and the feat is surely one of the most remarkable results of the long experience of the Roman builders.

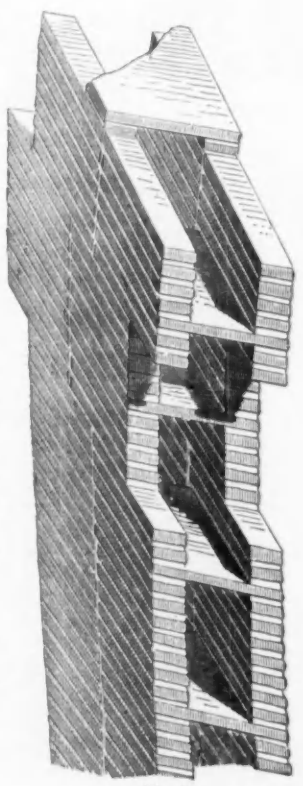


Fig. 24.

The construction of the vault may be irreproachable, but it must be acknowledged that the compartments with which it is decorated have but slight relation to the ribs with which it was constructed. I give the detail on a large scale (Figs. 24 and 25) of a portion of the ribs of the Basilica of Constantine.

The figure at the left shows a bored rib, that to the right a rib still buried in the filling, and, as can be seen, the ribs follow the salient sides of the larger octagonal caissons. Thus far their position is happily chosen, but the architects who decorated the edifice wished to fill the spaces between the large octagonal caissons with small square ones, and the builder, bending to this fancy, was compelled to cut into the ribs to a depth equal to that of the square caissons which they crossed (Fig. 25). The lack of accordance between the structure and the decoration was hidden by an expedient which at first glance may appear strange, but which, I think, should not be too severely condemned from the point of view of art. To put the form of an edifice in direct opposition to the fundamental principles of its construction, to hide the frame, which plays an important part in the equilibrium of its masses, would be to present to the eye something which the mind could not accept, would be to be lacking in taste by offending the intellect by presenting to it an evident falsehood.

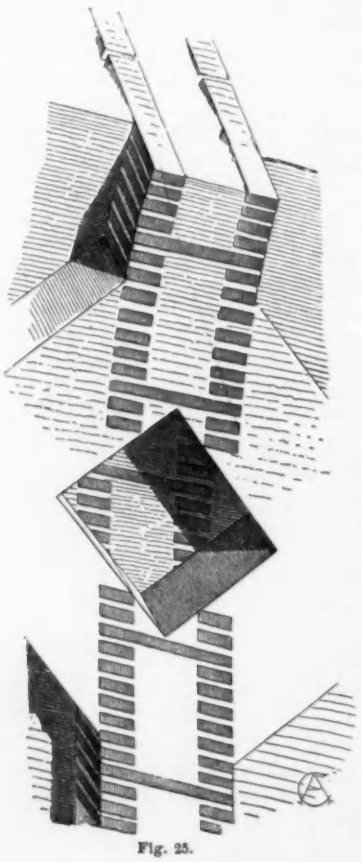


Fig. 25.

But I do not think we would be justified in saying that in covering the armature of brick that the Romans were concealing from the spectator one of the essential parts of the structure. The armature of a Roman vault was but a simple expedient of the work yards. It was useful during the construction; it was an auxiliary to the raising of the vault, but it lost its value and its *rôle* as the masses were consolidated; and when finally the mortar was firmly set it ceased to have an individual existence and became an integral part of the vault itself. From this moment the Roman architect no longer saw either filling or frame, but considered the whole as a concrete mass, and he may well be excused for not expressing in the decoration a distinction which, in his eyes, no longer existed in the structure.

Hence the cases where the ancients put the skeletons of their vaults in evidence are extremely rare. I can cite as an example of vaults where there exists a perfect concordance between the armature and the decoration only the vault of the double temple of Venus and of Rome. Unfortunately the upper part of this remarkable vault has been entirely destroyed, and the vestiges of the lower part which still remain are so incomplete and so fragmentary that a great part of its restoration must be theoretical; therefore the details of its construction, which an examination of the ruins seemed to me to make clear, and which I show in Fig. 26, are not given as certain, though they are quite probable.

The caissons were square, and the ribs of the armature corresponded with the uninterrupted ridges between them, lying in planes parallel or perpendicular to the axis of the vault, the whole forming a network of large meshes whose sides followed the generators and lines of right section of the vault.

The dimension along the generators of the vault is not so great in these ribs as in those of the Basilica of Constantine, but the ribs are quite solid, instead of being of openwork, like those of the greater part of the Roman edifices.

The manner of making these frames of brick, these salient ribs which show in relief in the intrados, needs no explanation. As shown in the sketch, the ribs of brick and the form (probably of wood) which served as a mould formed, before the building of the mass of the vault, a solid whole. The horizontal members braced the transverse arches and, kept in place by the moulds for the caissons, together formed between the centring and the filling a slight vault, partly of masonry, partly of wood, which had a *rôle* analogous to that of the continuous network of brick shown in the first plate. Here we find an exact concordance between the structure and the form; the architect has incidentally used the members of brick ornamentally, but he was in no way bound to do so, from the point of view of art, and the concordance in the vaults of the temple of Venus and of Rome does not seem to me to be of sufficient importance to give any decided superiority to this edifice.

We have reviewed the principal types of armatures with radiating

joints; if now a view is taken of their applications as a whole, one will appreciate, with no further explanations, both the services which they rendered and the guarantees of success which they gave during the construction of the vaults. But it may be asked, aside from these

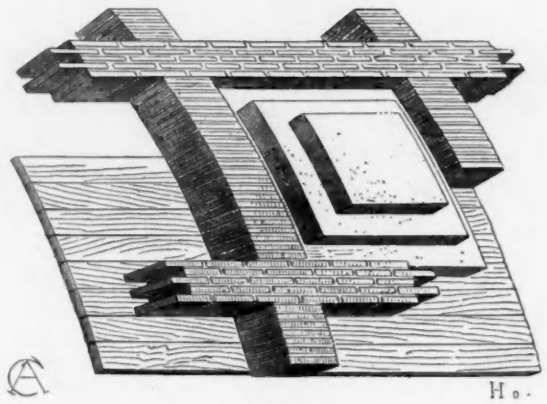


Fig. 26.

advantages, was it not to be feared that their use involved some dangers? Would not these courses buried in the thickness of the vault form an incompressible core in the still wet rubble? enclosed in masonry which would shrink, might they not hinder its movements and cause cracks or fissures? If this had really been the case, the armature which facilitated the building of the vaults would have hastened or perhaps prepared their ruin. But happily the case was quite different; the vaults were not masses cast in a single piece, and the general progression of the construction in courses greatly reduced the danger of contraction; each course quickly reached its final volume, the shrinkage took place course by course, and movements of the whole mass being thus avoided there was less danger of fracture. This applies not only to the armatures we have just described but, without the necessity of recurring to it later, it will be found to be equally true of the new kind which we are about to take up.

(*To be continued.*)

OUR ILLUSTRATED ADVERTISEMENTS.

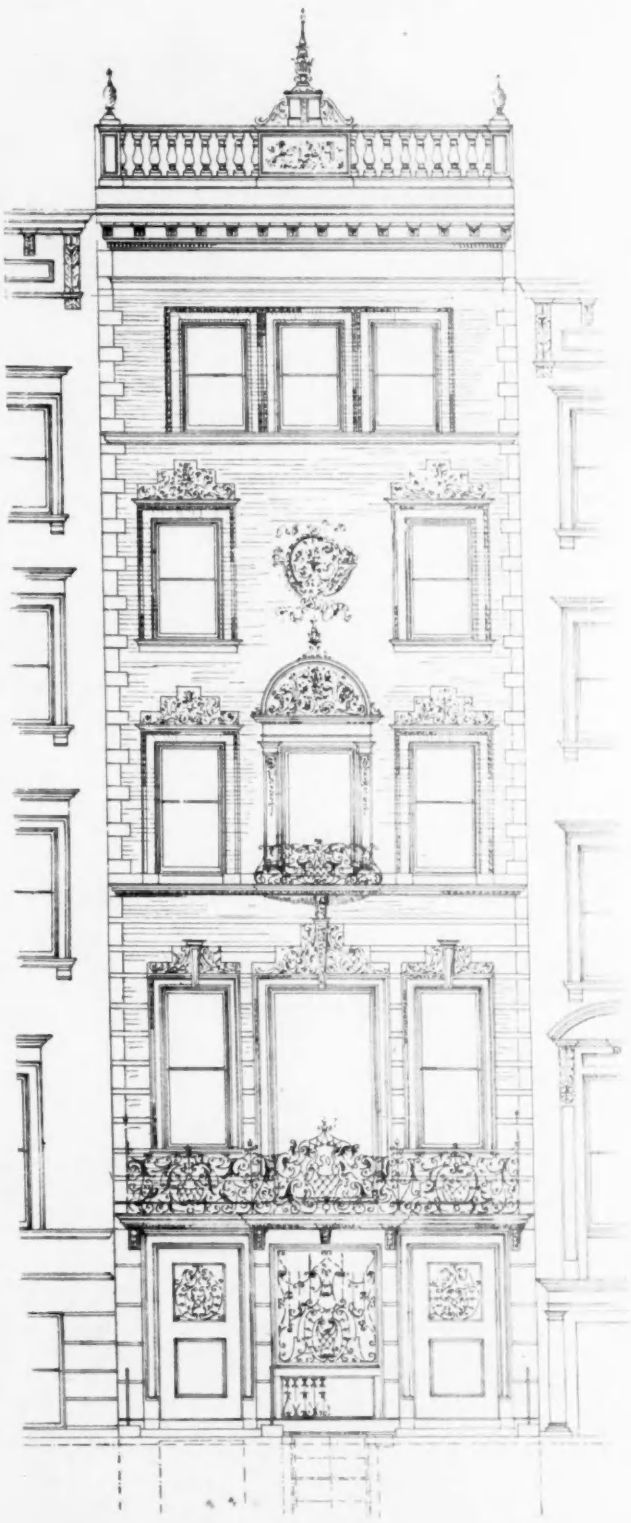
SAN GIORGIO IN VELABRO

Is number two of the Hydraulic-Press Brick Series (see page vii). It was founded in the fourth century, rebuilt in the seventh, and the portico was added in the thirteenth.

At the base of the tower is seen the arch of the Silversmiths. Our readers, by referring to the same advertisement last month, will see how closely similar this tower is to that of S. Maria in Cosmedin. In this connection let us state that we have completed arrangements for our heretofore announced article upon the Brick Towers of Rome, only our scheme has grown to cover all Italy. It is with greater pleasure that we announce the writer of the series of articles,— Mr. C. Howard Walker, of Boston,— who needs no introduction from us, to architectural readers.

MADONNA AND CHILD.

The Atwood Faience Co., of Hartford, Conn., have joined the movement started by the Hydraulic-Press Brick Companies, and their advertisement is to be watched each issue. A series of reproductions of the Della Robbia work will be presented. The initial one, on page xv, is a tympanum that crowns a door in the Via dell' Agnolo, Florence. It is one of the finest of Luca della Robbia's works. The background is blue, the figures white, the floral motive in the archivolt is in colors.



HOUSE FOR J. W. HENNING, ESQ., NEW YORK.

JAMES BROWN LORD, ARCHITECT.

This elevation was crowded out of the September number, in which were published a scale detail of the upper portion and a photograph of the front. The elevation above is reproduced at a scale of one eighth of an inch.

THE WARREN BUILDING, NEW YORK.

McKim, Mead & White, Architects.

This building, located on the corner of Broadway and 20th Street, is one of the earlier buildings in light brick and terra-cotta. These materials were made by the Perth Amboy Terra-Cotta Co. It is thoroughly fireproof, the contract for this work going to the Raritan Hollow and Porous Brick Co., of New York. Messrs. M. Reid & Co. were the general contractors. Dyckerhoff, Portland, and Brooklyn Bridge brand Rosendale cements were used in the construction.

THE terra-cotta work in the new Tremont Temple, Boston, is well along, and as soon as the steel work is ready, which has been the reason of delay, the building will be rapidly pushed forward. This terra-cotta is some of the best work the Perth Amboy Company has turned out, and is very beautifully modelled. As an instance of the care bestowed on the details, this little terminal to the balcony floor arches is published.

TRADE PUBLICATIONS.

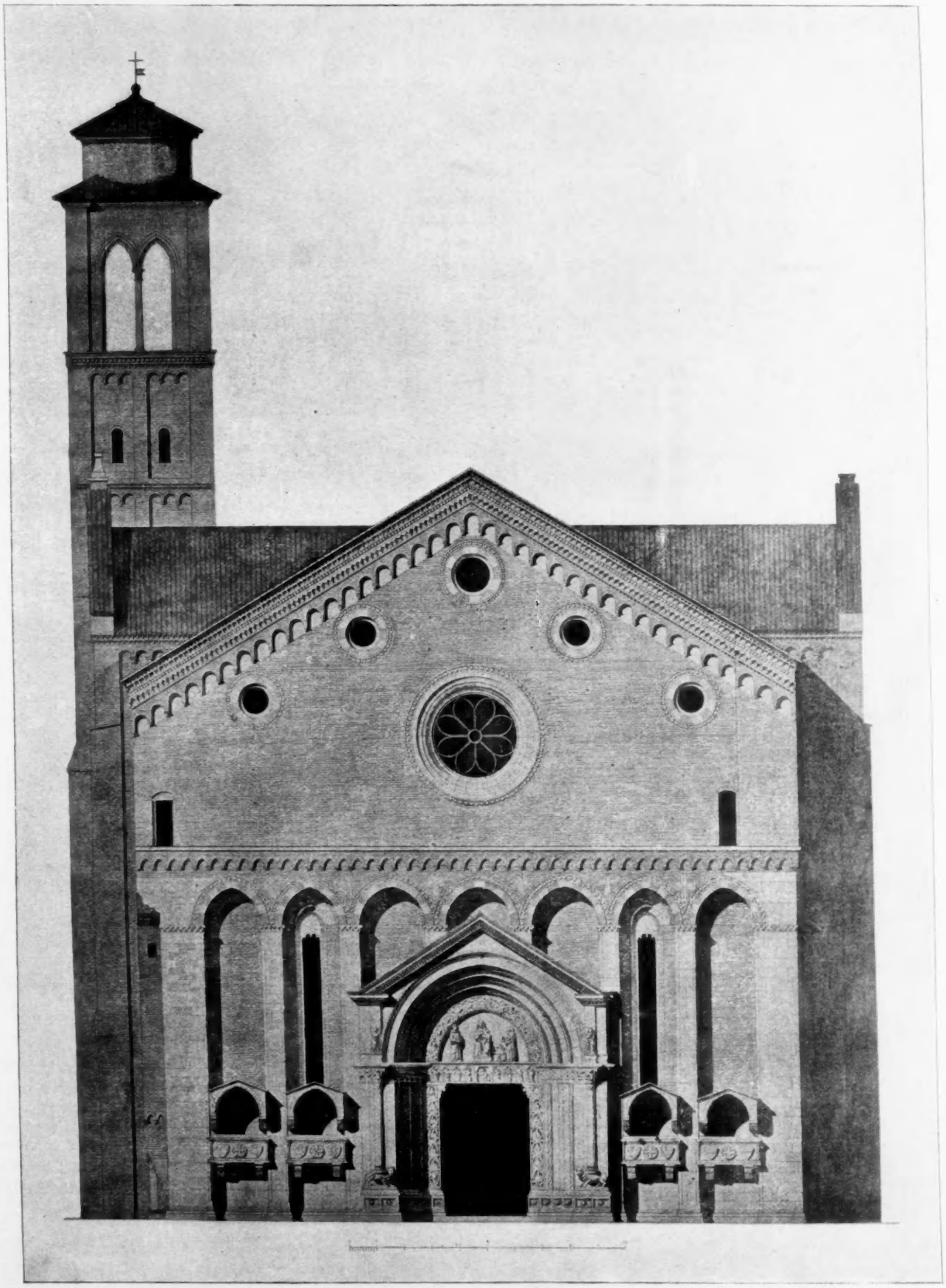
WE are, perhaps, a little late in the acknowledgment of the new catalogue of the Hydraulic-Press Brick Company. However, it is in its way such a masterpiece that we feel that it will not even now be amiss to make some short review of what it contains. The form in which it is issued is a most excellent one. All the illustrations are printed on separate sheets of heavy card texture, and enclosed in a substantial leather case, permitting the extraction of any particular sheet or sheets for such use as may be required without disturbance of the others. The first sheet of matter contains a table of brick measurements that were obtained by actual measurement of over one hundred different buildings built of their brick. The value of these tables is self-apparent. Following this are some sixty sheets of outline of moulded bricks, the cuts being the exact size of each brick represented. This last is supplemented by nine sheets of fine illustrations, some dozen to a sheet, of designs of moulded brick of particularly artistic patterns, also ten of illustrations of different styles of enamel brick.

WE wish to acknowledge a very handsome little booklet, entitled "Seen in a Golden Light," issued by The Platt Pressed Brick Company, of Des Moines, Ia. The originality and taste of this vest-pocket catalogue warrant it receiving attention wherever sent. On the first page is a cut of a golden brick, with the word "Platt" stamped in the centre, and following which, one on each page, are aphorisms pertinent to the subject stamped upon a brick. "Golden Light Shed by a Golden Buff Brick," occupies page 4, as a legend to be taken to the heart for future reference. Various notes and assertions are made on different kinds of bricks, and you are informed upon a bricklet that "You can obtain more light on the subject by addressing The Platt Pressed Brick Company, Des Moines, Ia."

HALL & KNOWLES, 7 Walnut Street, Philadelphia, have issued a small pamphlet that contains much information regarding North's Portland cement, for which they are the American agents. There are some six pages devoted to tenable tests from seven-day to twenty-four-day duration, with the results thereon, also a table of the chemical composition of the cement as determined by E. Roussel, La Chef Des Essais-Malines.

THE EMPIRE FIREPROOFING COMPANY — offices, Pittsburg and Chicago, factories at Brazil, Indiana, and Empire, Ohio — report a good business. This company has furnished the fireproofing material for some of the largest and best-known buildings in the country. A recently issued catalogue of this concern is most profusely illustrated with their method of fireproof construction.

THE PEERLESS BRICK COMPANY, of Philadelphia, have issued a new catalogue in which is illustrated their numerous patterns of moulded brick. There are many practical hints on the various ways these designs may be used in construction. A detailed price list is incorporated in the catalogue, — Peerless Brick Company, Philadelphia, Penn.

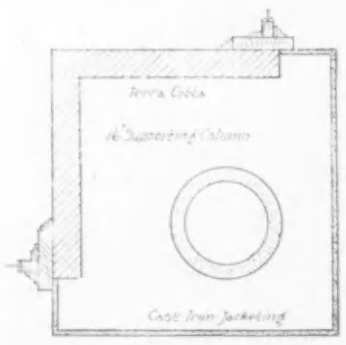


ELEVATION OF SAN LORENZO, VICENZA, FROM STRACK.

SUPPLEMENTARY ILLUSTRATION TO "BRICK AND MARBLE IN THE MIDDLE AGES."

The McCarthy Building.

Chas. E. Colton, Arch't., Syracuse, N.Y.



CORNER, EXTERIOR COLUMN

IT will be a matter of surprise to many of our readers as it was to us, to find in a city the size of Syracuse so large a building as the above entirely devoted to the retail dry goods trade of one house, — Messrs. McCarthy & Co. The building is built according to the most improved methods of steel skeleton, fireproof construction, the columns being cased with three-inch terra-cotta, the floors filled and protected by hollow tile arches of porous terra-cotta. The detail here given shows the casing of the corner column. The underwriters have given the construction more than usual attention, and are extremely well satisfied with it. The exterior is buff brick furnished by Fiske, Homes & Co., Boston, with terra-cotta to match made by the Perth Amboy Terra-Cotta Co. The fireproofing is that of the Staten Island Terra-Cotta Lumber Co., of New York.

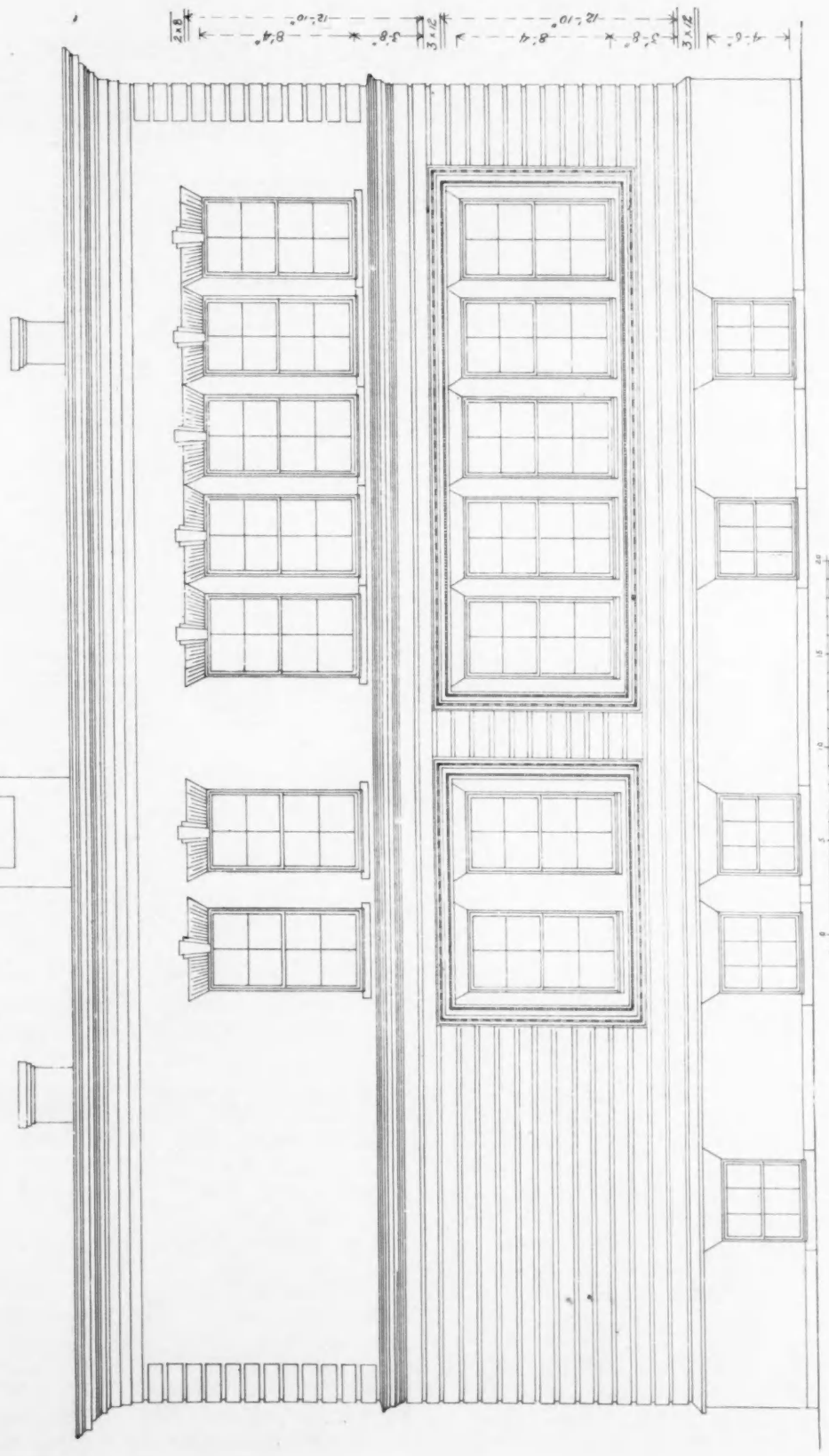
RESIDENCE OF MR. W.H. GORSLINE. EAST AVE, ROCHESTER, N.Y.
J. FOSTER WARNER ARCHITECT

BUFF BRICKS FROM EASTERN HYDRAULIC PRESS-BRICK CO. TERRA-COTTA FROM PERTH AMBOY TERRA-COTTA CO.

UNION HILL SCHOOL, WORCESTER, MASS.

EARLE & FISHER, ARCHITECTS.

At three eighths inch scale. See page 227 for plan



UNION HILL SCHOOL, WORCESTER, MASS.

Elevation at one eighth inch scale. See page 227 for plan.

EARLE & FISHER, ARCHITECTS.

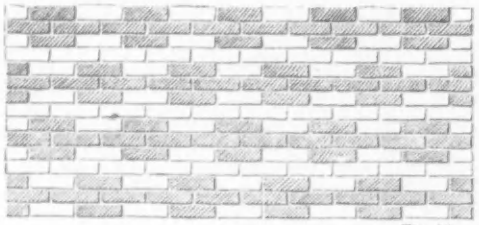


Fig. 14

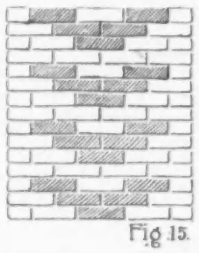


Fig. 15.

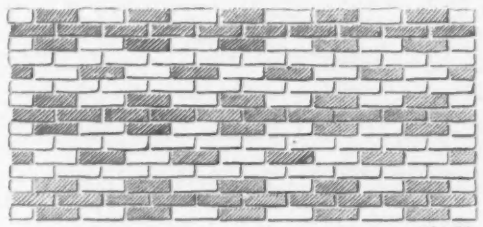


Fig. 16.

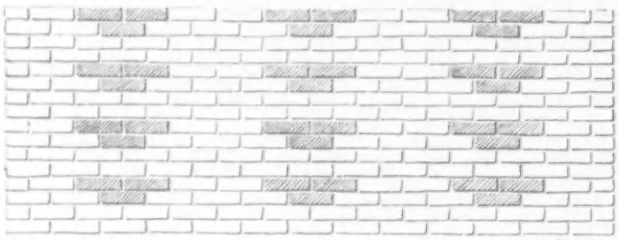


Fig. 17

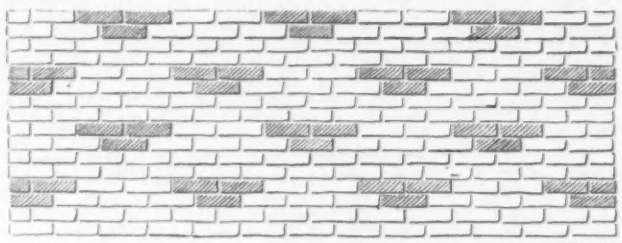


Fig. 18

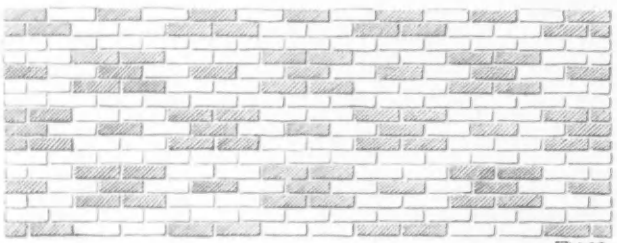


Fig. 19.

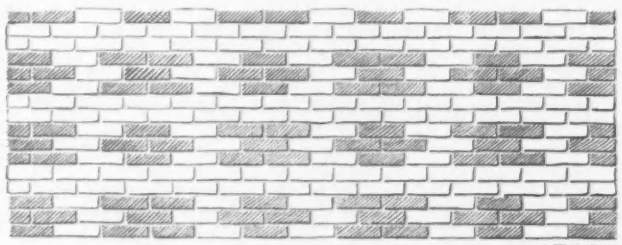


Fig. 20

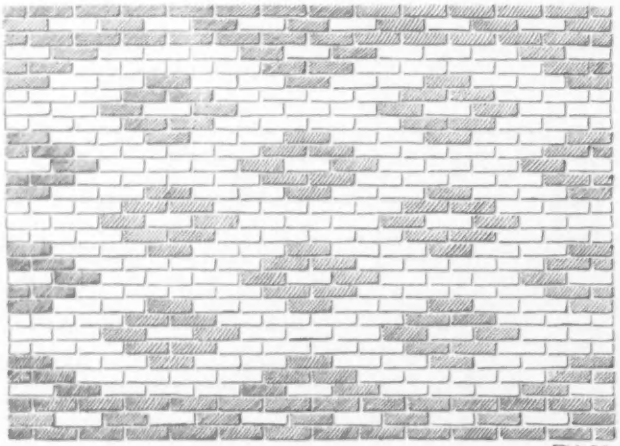


Fig. 21.

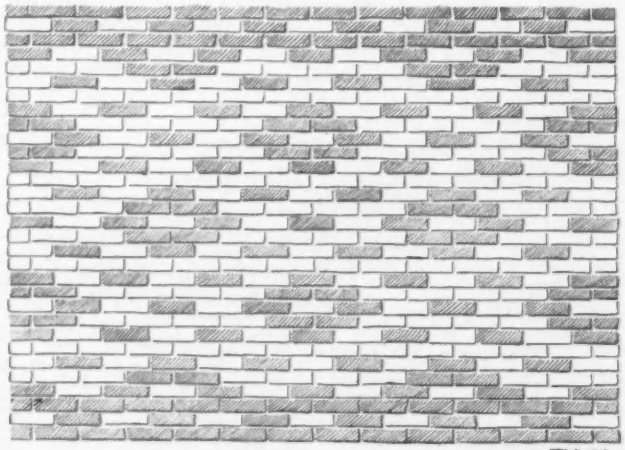


Fig. 22.

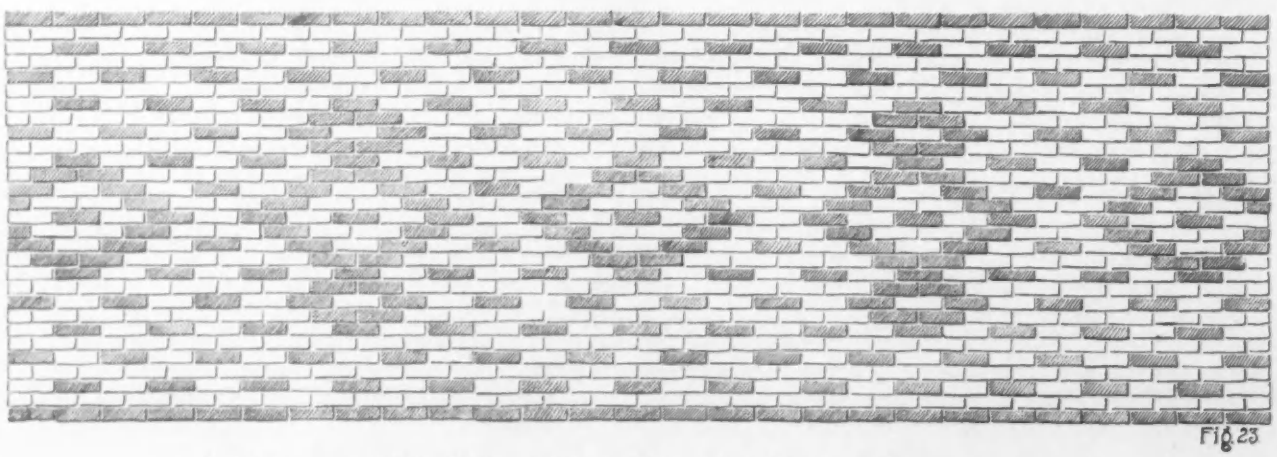


Fig. 23

DESIGNS FOR PATTERN WORK, AMERICAN BOND, TWO COLORS. (See Contractors' Department.)

THE BRICKBUILDER.

AN ILLUSTRATED MONTHLY DEVOTED TO THE ADVANCEMENT OF ARCHITECTURE IN MATERIALS OF CLAY.

PUBLISHED BY

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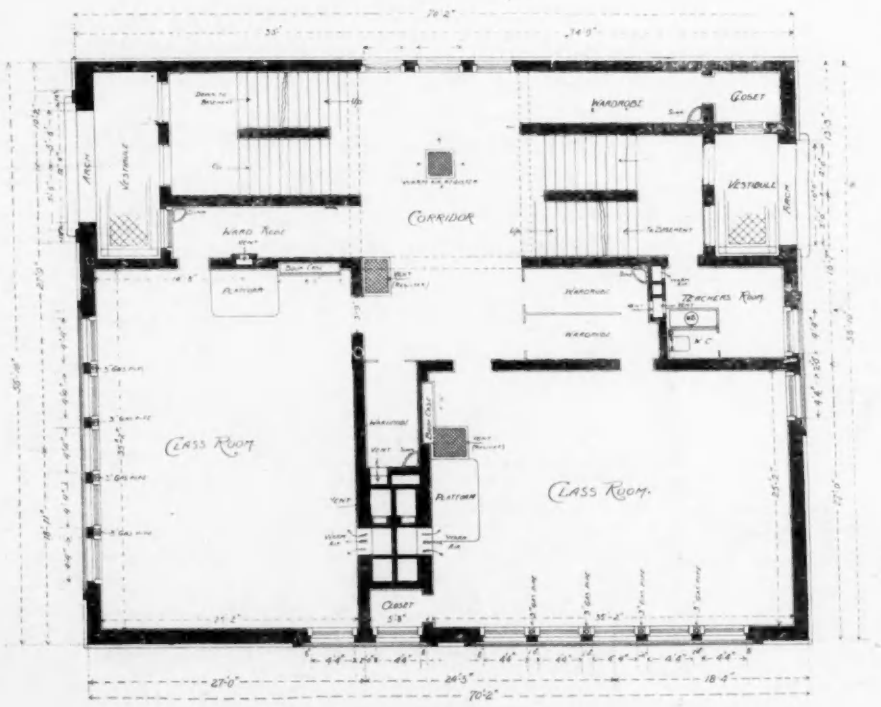
PUBLISHERS' STATEMENT.

No person, firm, or corporation, interested directly or indirectly in the production or sale of building materials of any sort, has any connections, editorial or proprietary, with this publication.



PLAN OF UNION HILL SCHOOL, WORCESTER. EARLE & FISHER, ARCHITECTS.

THE large office building opposite the Post Office, on Devonshire Street and Spring Lane, Boston, is an example of the durability of sandstone which we commend to the attention of our esteemed contemporary *Stone*. Messrs. Woodbury & Leighton have erected a scaffolding covering the entire building with a projecting shed to extend over the sidewalk and protect pedestrians from the chunks of sandstone which have been dropping without warning. This building is one of the comparatively new buildings of Boston. It is of red brick with brown sandstone trimmings. These trimmings, little as they project, have been a menace to people in the streets, and the owners are none too prompt in their action to at least make the building safe. The present intention is to first cut off the projections, and if the stone inside the wall is as rotton as that which projects, it will be entirely cut out, and brick or terra-cotta substituted. Specimens of the stone which we examined in Woodbury & Leighton's office, and also picked up on the sidewalk, crumbled like dried mud, between the fingers. From the inside of the building, window-sills were found with the projecting two or three inches nearly cracked through. A few examples of this sort should be sufficient to caution architects against any kind of sandstone that they do not actually know has stood a good long-time test. The day of crude, rockfaced sandstone is one we can now look back upon, as far as the best architectural practice is concerned, and the material, in any finish, is steadily giving way to brick and terra-cotta.

APROPOS of the fad, for such is it becoming, of using dark headers in Flemish bond, an interesting comparison may be made between those buildings where the contrast is very marked and those where the designer has been careful that there should be a little carelessness in sorting and laying the brick. One of the best examples of the latter case is Peabody & Stearns's Charlesgate stables, at the corner of Newbury Street and Massachusetts Avenue in this city. The regularity of the bond is not marked, but it is there, all the same, and counts very strongly in its delightful surface effect. We do not think of that wall as a decorated wall, though it has the charm of well-ordered variety. If, on the other hand, we turn to some plain wall surface, very carefully laid with dark headers, we cannot help having the pattern forced upon us to an extent which badly interferes with the architecture of the building.

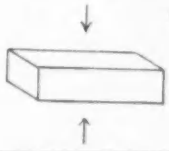
IN the smaller towns throughout the country there is an immense quantity of really good detail work in brick. Here and there a cornice or chimney, or belt course is found which is just as well designed, just as good in color as much of the old work in Europe we have a way of raving over. The cornice seems to be most often successfully done, which is perhaps natural on account of the fact that cornices on brick buildings are the most usual problem in detailing, the chimneys seldom coming in for anything in the way of decorative treatment.

A SERIES of careful tests at the Watertown, Mass., U. S. Arsenal is always of interest to architects no matter what the building material. The testing machine has a capacity of 800,000 pounds, and the work done by it is absolutely accurate. We have been furnished the results of brick tests made for the Eastern Hydraulic-Press Brick Co., of Philadelphia, and give some of the tables here.

ABSORPTION OF WATER AFTER IMMERSION OF ONE WEEK.

Test No.	Description.	Weight Dry.		Absorption of Water.			
				Total.		By Weight.	By Volume
		Lbs.	Oz.	Lbs.	Oz.	Per Cent.	Per Cent.
7,054	Shade 200	5	7¼		6	6.9	14.5
7,057	Shade 220	5	7		4¾	5.5	11.6
7,059	Shade 300	5	5¾		6¾	7.9	16.1
7,061	Shade 390	5	4¾		6	7.1	14.5
7,064	Shade 410	5	7		4¾	5.5	11.4

COMPRESSION TESTS.



Compressed surfaces faced with Plaster of Paris to secure even bearings in the Testing Machine.

Test No.	Description.	Dimensions.			Sectional Area Sq. In.	First Crack Lbs.	Ultimate Strength.	
		Height.	Compressed Surface.				Total Lbs.	Lbs. per Sq. In.
7,053	Shade 200	2.21"	4.01"	8.11"	32.52	332,000	481,900	14,818
7,054	Shade 200	2.21	4.00	8.08	32.32	381,000	509,100	15,752
7,055	Shade 210	2.26	4.00	8.08	32.32	371,000	445,100	13,771
7,056	Shade 210	4.00	2.18	8.02	17.48	102,900	162,900	9,319
7,057	Shade 220	2.20	3.95	8.10	31.99	335,700	519,900	16,252
7,058	Shade 220	2.20	3.97	8.08	2.08	339,000	464,700	14,485
7,059	Shade 300	2.18	4.08	8.12	33.13	328,000	447,000	13,492
7,060	Shade 300	4.04	2.21	8.09	17.88	105,800	165,700	9,237
7,061	Shade 390	2.20	3.97	8.16	32.40	302,000	392,800	12,123
7,062	Shade 390	2.22	3.98	8.15	32.44	295,000	454,000	13,995
7,063	Shade 410	2.22	3.98	8.10	32.24	355,000	486,200	15,081
7,064	Shade 410	3.94	2.22	8.19	18.18	166,000	180,800	9,945

TRANSVERSE TESTS.

Supported at ends, loaded at the middle. Middle loaded over a length of 1".

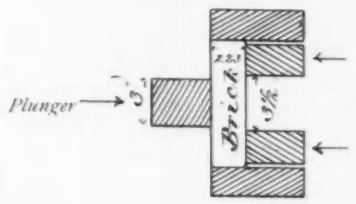
Test No.	Description.	Distance between End Supports.	Dimensions.		Ultimate Strength.	
			Breadth.	Depth.	Total Lbs.	Modulus of Rupture R.
206	Shade 200	6"	4.01"	2.25"	2,110	936
207	Shade 210	6	3.98	2.22	2,685	1,232
208	Shade 220	6	4.01	2.18	2,257	1,066
209	Shade 300	6	4.05	2.22	1,660	756
210	Shade 390	6	3.97	2.22	2,258	1,038
211	Shade 410	6	4.02	2.23	2,163	974

COMPRESSION OF HALF BRICKS.

Fragments after Transverse Tests were made.

Test No.	Transverse Test No.	Dimensions.			Sectional Area Sq. In.	First Crack Lbs.	Ultimate Strength.	
		Height.	Compressed Surface.				Total Lbs.	Lbs. per Sq. In.
7,123	206	2.25"	4.01"	4.11"	16.48	174,000	200,100	12,142
7,124	206	2.25	4.01	4.00	16.04	196,000	216,600	13,504
7,125	207	2.22	3.98	4.09	16.28	175,000	200,050	12,288
7,126	207	2.22	3.98	3.93	15.64	199,000	216,100	13,817
7,127	208	2.18	4.01	4.00	16.04	175,000	242,800	15,137
7,128	208	2.18	4.01	4.06	16.28	218,000	262,600	16,130
7,129	209	2.21	4.05	4.00	16.20	125,000	195,300	12,055
7,130	209	2.21	4.05	4.10	16.60	149,000	204,800	12,337
7,131	210	2.22	3.97	3.52	13.97	146,800	171,900	12,305
7,132	210	2.22	3.97	4.62	18.34	187,000	230,800	12,584
7,133	211	2.23	4.02	4.19	16.84	159,000	212,000	12,589
7,134	211	2.23	4.02	3.98	16.00	164,000	210,300	13,144

SHEARING TESTS.



Test No.	Description	Shearing Dimensions.	Shearing Area.	Transverse Fracture Developed on Tension Side.	Shearing Strength		Surface Sheared.
					Total Lbs.	Lbs. Per Sq. In.	
		Inches.	Sq. inches.	Lbs.			
227	Shade 210	2.23 x 3.99 x 2	17.80	4,800	20,780	1,167	One
228	Shade 220	2.21 x 3.97 x 2	17.55	7,600	19,250	1,097	One
229	Shade 390	2.20 x 3.96 x 2	17.42	10,100	17,220	988	Two

(Signed) J. W. REILLY, Major Ordnance Dept., U. S. A.,
Correct. (Signed) J. E. HOWARD. Commanding.

FIREPROOFING.

A Department Conducted in the Interests of Building Construction to Prevent Loss by Fire.

FIREPROOFING CITY HOUSES.

AN article by C. H. Blackall in the September number of THE BRICKBUILDER, under the above caption, purports to criticise a description of Manly N. Cutter's fireproofing system which appeared in the August issue of *The Architectural and Building Monthly*.

To criticise the critic is my province now, and as Mr. Blackall starts out with an erroneous statement and draws conclusions from false promises the task is not a difficult one.

Mr. Cutter has not claimed, as his critic asserts, that the fireproof structure built according to his system will cost "less than one per cent more than if built with the ordinary wooden inflammable construction." Not quite three per cent was Mr. Cutter's statement, and if Mr. Blackall had glanced at the comparative estimates which were reprinted in his article he could easily have seen what a palpable blunder he was starting out with.

Mr. Blackall's next statement is a little cloudy. He says: "Although an ordinarily well-built house with wooden floor-beams, hollow wooden walls, and hollow furrings practically very seldom catches fire or is injured by any conflagration unless the flues or the electric wires are wrongly disposed, and although, judging by results, the wooden floor and wall construction is actually not as bad as it sounds, there is, nevertheless, no question but that some form of reasonably fireproof construction would be far preferable if it fulfilled the same conditions of comfort and expense."

I do not quite understand what mental reservation Mr. Blackall seeks to cover under that word "practically." Any house that only catches fire theoretically ought to be good enough, but the records of the New York Fire Department during the three months ending Sept. 30 show that twenty-one "ordinarily well-built houses" were the victims of fires which "practically" left only an inorganic residue on the sites.

Mr. Blackall makes another mistake when he says that "Like nearly all new things, there is little that is unusual in this construction."

There would have been nothing unusual in electric traction if it were not for the dynamo, and if Mr. Blackall ignores the fundamental principle in Mr. Cutter's system he can hardly expect to find much that is unusual. That principle is the steel wire which, under tension, binds posts and beams, walls and floors in one entity, and secures the full factors of strength and stability, all the other accessories being only required for warmth, convenience, and appearance. It is this wire which makes the thin wall practicable and secures the gain, on outside walls alone, of ten to fourteen inches in floor space, a circumstance entirely ignored by Mr. Blackall. Thus is also answered Mr. Blackall's statement that "a four-inch wall is entirely too flimsy," for in Mr. Cutter's system this four-inch wall, with its wire band, is much stronger than the brick wall of ordinary construction. But to show how far a critic can get away from facts, I will add that there are many houses in New York City with four-inch walls of brick backed with terra-cotta between iron uprights, which, even without the wire netting, are not considered either flimsy or lacking in strength. Mr. Blackall's suggestion in regard to outside cement plaster has been proved impracticable in hundreds of cases in this climate.

A total revolution in conventional methods can hardly be considered anything but unusual, and Mr. Cutter's system is destined to cause such a revolution as surely as it can be proved that its cost can be closely approximated to that of the present ordinary methods, and this approximation Mr. Cutter has demonstrated in the clearest manner by estimates from reputable parties covering every item in either kind of construction. These estimates are now before the writer, and the names of the parties are sufficient refutation of Mr. Blackall's innuendo that "It certainly seems as if either the New York prices quoted were very high for masonry and timber or extremely low for iron and terra-cotta." Mr. Cutter would indeed be a fool to enter the arena with such a flaw in his armor as this critic most ungraciously hints at. The estimates which he quotes are *bona fide* bids from J. B. & J. M. Cornell, New York, Raritan Hollow and Porous Brick Company, New York, E. M. Waldron, contractor and mason, New York, Jeans & Taylor, builders, New York, and, instead of the iron and terra-cotta being quoted extremely low, I have, for the latter item at least, a lower quotation from the Staten Island Terra-Cotta Lumber Company of New York.

Now, when Mr. Blackall goes in for estimates on his own account, his calculation is simply an outrage upon mathemetical exactitude, and entirely unworthy of even the veriest tyro in the science of estimating. While Mr. Cutter states with exact precision the cost at current market price and current value of labor of every item entering into the construction of three houses built according to his method, Mr. Blackall proceeds to give such vague and incompetent information as the cost of brickwork per square foot of surface in Boston, and even here he uses his pet qualifying adverb, the figure he gives being "practically" fifty cents. All his estimates are of the same character, — so much per foot for so and so, — and there is only one that needs or deserves to be considered. That is where he assumes that Mr. Cutter's sysem provides for ten-inch iron beams for a four-story American basement house with sixteen-foot span. We hardly looked for this absurdity from an architect of Mr. Blackall's standing. Mr. Cutter's estimate is for eight-inch beams, and if the building laws of New York did not prohibit, even much lighter beams could be used with a factor of safety exceeding that generally required.

One word in conclusion on the question of insurance. This is what Mr. Blackall says: —

"Even if the cost of such fireproof construction did not exceed ten per cent more than the cost of a similar building erected with the ordinary construction, the greater sense of security resulting, as well as the diminished insurance premiums, would surely make it an object, in the majority of cases, to adopt the fireproof construction. Unfortunately the fire-insurance companies do very little to foster such attempts. Generally speaking, the saving in insurance rates affected by using a thoroughly first-class construction is far less than the interest on the added cost over that of a shoddy building. Or, in other words, assuming that a building is to burn down sooner or later, it would pay an owner better to build poorly than to build well. Fortunately there are a great many property owners who are more far-sighted than the insurance companies, and are glad to welcome a construction such as Mr. Cutter has devised."

If Mr. Blackall stopped at the first sentence he would have done well, but his fortunate and unfortunate qualifications simply make a seesaw of his argument. I have read letters from the presidents of fire-insurance companies endorsing Mr. Cutter's system in most unequivocal terms and "practically" pledging themselves to foster it to the extent of their power.

JNO. G. LYNCH.

ANOTHER VIEW OF THE ABOVE SUBJECT.

TO THE EDITOR OF THE BRICKBUILDER:

Sir, — The article on "Fireproofing of City Houses" in your September number brings to the front that application of fireproof building methods that will be conceded, on thoughtful consideration, to be the most important of all the uses to which fireproof building can be applied.

When a commercial building burns the valuable papers and records of the occupants are almost invariably preserved by the fireproof vaults or safes, and the tenants are put to the inconvenience merely of securing new office room. But when buildings occupied as places of residence are destroyed there is a destruction of homes and all that that word implies; and one needs only to be burned out once, and return from business to find his wife and children without shelter, except through the kindness of neighbors, and to hear for months afterwards the regrets expressed by the family for the loss of some article of furniture or of ornament, or for the loss of some keepsake, to decide that if there is any class of building that should be made absolutely fireproof it is the buildings in which men have their families, and in which they hope to greet them on their return.

That the loss by fire in dwellings is no small matter may be shown by a reference to the valuable fire statistics complied by the New York *Chronicle*. These show that thirty-five per cent of all the fires in the United States occur in dwellings and tenements. During the nine years from 1882 to 1890 there were dwellings and tenements destroyed to the amouut of $79,741,400. Besides these there were boarding-houses destroyed to the value of $2,500,000.

When we consider this vast financial loss, and in connection with it the suffering and hardship that must have resulted to the inhabitants of the houses that were consumed, we must feel grateful to THE BRICKBUILDER for bringing forward for discussion a question a proper solution of which must tend to the safety and security of our families.

The question is how to make our dwellings fireproof, and the writer believes they should be so made, regardless of cost, but as long as the financial question is bound to intrude itself into the matter of housebuilding the fireproofer must benefit his fellows without adding materially to the cost of the home.

The first consideration is to abolish everything combustible from the structure, the burning of which would render the house uninhabitable, and to retain all those features of the house as at present constructed that give it what security it has from the ravages of fire.

The ordinary city house with its brick or stone front wall and brick rear and party walls is as near fireproof as it is possible to make it as far as its exterior walls are concerned, and nothing is gained either structurally or as a fireproofing method by substituting steel columns for the ordinary brick party walls, as the brick will stand more fire than the steel and the latter will cost with its fireproof enclosures fully as much as the brick.

The combustible parts of the ordinary house, and the parts that render the house uninhabitable when destroyed are the floors, partitions, and roof, and when we have them fireproof and durable we may rest assured that our house will not vanish into smoke. Some of the trimming may be destroyed, but the house will not be overrun by the fire.

Of the combustible parts of the house, the roof and the floors are the most important, and the writer proposes to describe what to him seems to be the best and cheapest fireproof floor and roof, and the only good one so far as he knows that is capable of competing in price with the ordinary construction. That the idea is patented should not prevent our recognizing its value, if it is a step towards safer and more durable homes. But first as to the difference in cost between the present combustible method and the one to be described.

Taking Mr. Cutter's figures for the cost of the floors and roof on the ordinary non-fireproof construction, we have

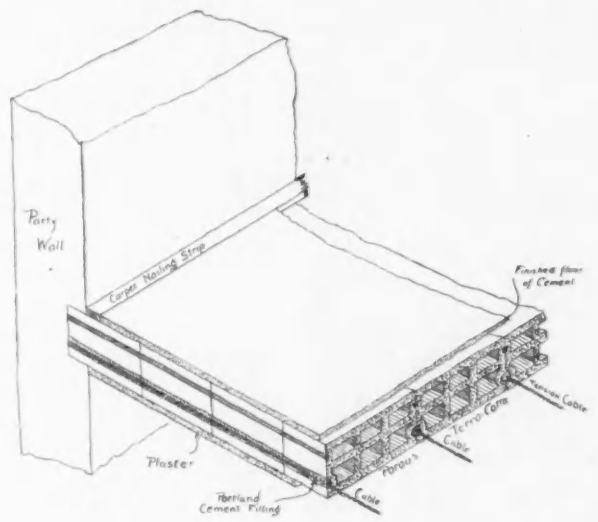
Floor and roof timbers	$1,743.00
Rough floors	810.00
Finished floors	1,500.00
Total for floors and roof	$4,053.00

The writer has added to Mr. Cutter's figures $1,500 for finished floors. These did not enter into Mr. Cutter's calculation, but as the floor herein described does not require any finished wood floors their cost should be added to that of the timbers and rough floors.

The writer has obtained from the Lee Fireproof Construction Company the following figures for floors and roofs in three houses described by Mr. Cutter, based on 13,000 square feet of floor and 3,250 square feet of roof. These figures cover the cost of the floors ready for the carpets and of the roof ready for the roof boarding.

Cost of Lee hollow tile floors	$3,900.00
Cost of Lee hollow tile roofs	910.00
	$4,810.00

This represents an additional cost of $757 for the three houses, or $252.33 for each house.



For the benefit of those who are unfamiliar with the Lee floor, it might be well to state that it is an extension of the end-construction-flat-arch idea.

A tension member is added to the bottom of the arch in the shape of a twisted steel cable of two strands. This tension member is buried in the tile near the bottom in a bed of Portland cement, which binds the tile and the cable firmly together. The arch thus becomes a genuine beam with the top in compression and the bottom n tension, and the spans can be increased to distances impracticable to the ordinary arch, while the depth of the floor is very small as compared with an arch doing the same work, and the thrust of the arch, being taken up by the tension member, disappears.

In the houses in question, the fireproof floors are supposed to be constructed on this method, and the finish of the floor to be concreted, with a smooth Portland cement surface. Around every room and passageway a narrow border of hard wood, two by three quarters inches is fastened to receive the tacks for fastening the carpets. Other than this there is to be absolutely no wood in the floor. The writer believes this makes the ideal fireproof and vermin-proof floor. The roofs to be built in the same manner, except that wood strips are to be dovetailed into the upper surface to receive the roof boarding.

As this article is growing to too great a length, the question of partitions will not be touched upon, but if owner and architects could be enabled to make the floors and roofs of houses as fireproof as they are at present making party walls, we would have houses that could not be destroyed.

The floor described is fireproof, vermin proof, strong, easily built, and low in cost, and, as there are no heavy I-beams to handle, the work can be done on any house by the mason contractor, and the architect has no other parties to deal with and no other contracts to make than he has at present.

WM. M. SCANLAN.

CHICOPEE, MASS.

MORTARS AND CONCRETES.

A Department devoted to Advanced Methods of using CEMENTS and LIMES in Building Construction.

IN subsequent issues of THE BRCIKBUILDER, it is the writer's purpose to enter upon a discussion of various concrete floor constructions. It will be the aim of the articles to have the various systems' presented in a complete and intelligent fashion, with drawings, details, and such data as may be necessary or of value in making estimates and calculations. It is to be understood that while these various systems are to be presented by the respective companies or individuals most interested in them, they are not to be of the nature of advertisements, and are to be impartially discussed upon their merits. In this way, it is hoped to bring greater attention to bear upon the use of concrete in fireproof floor construction and at the same time bring each system forward to present its own advantages. The criticisms will be open to any one competent to judge, and will be absolutely impartial and unbiased. It is believed that a series of such papers will form an interesting and important addition to our technical knowledge, and it is hoped that whosoever undertakes to present his work will do so in a complete and thorough manner, that the subject may be thoroughly understood and, if desirable, discussed, after the manner of papers in the technical societies.

IN regard to the recent discussion of the virtues of American Portland cement, a letter has come to hand from a prominent firm of American manufacturers that throws some further light on the status of the American product. It is given below and presents the true state of things. We all wish to see the American brands take the lead, and to be able to feel that when we specify a given brand we have not to resort to the testing machine with every lot of ten barrels. Neither do we want to be under the necessity of securing guarantees and strict specifications regarding the output. We want to feel assured, as we do, when we use some foreign brands, that we have but to name the brand, and to secure the desired results.

We do not hesitate to say that the American manufacturer is going to attain that standard, and shortly enable us to use it to the exclusion of all foreign brands. We are aware that there are lots of foreign cements in the market that do not compare with American brands, but the great point we maintain is not a comparison of American brands with inferior foreign brands, but with the high-grade cements that are in every way so eminently satisfactory.

ROSS F. TUCKER.

ROSS F. TUCKER, ESQ., Nov. 15, 1894.
Care THE BRICKBUILDER:

Dear Sir, — Having read with much pleasure your articles in THE BRICKBUILDER on "Concrete Construction," and "American *vs.* Foreign Portlands," etc., I have been impressed with their value, and in the name of the company I represent, — Empire Portland Cement Company, of Warners, N. Y., wish to thank you.

Although ourselves American makers, we quite agree with you that a large portion of the so-called Portland cement made on this side is entirely unworthy of the name. We consider it directly to our own benefit to have this subject of what constitutes a true Portland cement thoroughly discussed. It is only because so little is known by the average architect, engineer, or contractor, about cement, that such a condition of affairs is possible. We would also like to see a Government Testing Bureau for cement established, similar to that of Germany, at Berlin. This would not only determine the true scientific and practical worth of American brands, but would protect our people from spurious foreign brands, of which there is an increasing importation.

Let us say, in closing, that we will at all times appreciate your critical opinion of our "Empire" Portland Cement, as obtainable from dealers generally. We would also take pleasure in showing you our process of manufacture in detail if you will at any time favor us with a visit to Warners, N. Y.

Respectfully yours,
CHARLES H. SPENCER,
Gen. Sales Agent.

AMERICAN CEMENTS.

NATURE has supplied this country with practically inexhaustible deposits of hydraulic limestones, and in almost endless variety of combinations.

In order to classify these varieties and reach intelligent conclusions concerning them, the following arrangement may be taken as fairly representative, considered subsequent to calcination.

1. Common quick-lime.
2. Slightly hydraulic lime.
3. Eminently hydraulic lime.
4. Hydraulic cement.

The deposits from which all or nearly all of these classes may be obtained occur in nearly every State and Territory of the United States.

It is the presence of clay in greater or less proportions in these limestones that confer upon them their hydraulicity, or power to set and harden either in air or water.

The greater the proportion of clay in a limestone, up to a certain fixed limit, the greater will be its hydraulic activity.

COMMON QUICK-LIME.

Pure lime of itself contains no setting properties whatever. It is a base which, if combined with an acid, like silica, loses its caustic properties, and takes a new form known as silicate of lime.

The latter, if composed of correct combining proportions, will, upon the application of water, commence to crystallize and harden, whether in air or water, and without an appreciable development of heat.

Pure lime alone when subjected to water will in the process of hydration develop heat as high as 300° F., but it will not crystallize, as has so often been stated by eminent writers.

That pure limestone occurs in massive crystalline form is due to its chemical combination with carbonic acid. It will also crystallize when combined with sulphuric acid, as in calcined gypsum, or plaster of Paris.

But with water alone, it will not crystallize. Mortars made from pure lime and sand will attain a certain degree of hardness when used above ground, due mostly to the process of drying out, and possibly a slight amount of reabsorption of carbonic acid.

This process is so slow however as to be inappreciable during an ordinary lifetime.

This is easily proven by placing in water a sample of the oldest lime mortar to be found. If the lime is approximately pure, the mortar will in a few days crumble into mud, and the lime will be taken up in solution in the water, and if the water is changed frequently the lime will entirely disappear, leaving the sand as clean as when in its native bed.

SLIGHTLY HYDRAULIC LIME.

Lime that contains sufficient clay to enable it to be classed as slightly hydraulic lime will contain ten to twelve per cent of clay. This amount of impurities will not prevent the lime from slaking, although it will slake more slowly than will a lime that is pure or nearly pure.

It will not appear as white as the latter, neither will it develop so high a degree of heat during hydration; but as a mortar-making material for brick or stone masonry, it is vastly superior to that of pure lime, as it contains inherent setting and hardening properties

amounting — with the proportion of clay mentioned — to about thirty per cent of silicates or active setting matter, *i. e.*, hydraulic cement.

Such a lime when made into mortar with the requisite amount of sand will cement properly-moistened bricks so firmly together that in a few years the bricks, rather than the mortar, will be disrupted when subjected to tensile strain.

EMINENTLY HYDRAULIC LIME.

When clay is present in a lime to the extent of eighteen to twenty-two per cent it is classed as an eminently hydraulic lime. Containing about fifty per cent of hydraulic cement, it will, when properly calcined, then reduced to powder and hydrated, then thoroughly mixed with sand, produce a mortar that, for enduring qualities, when exposed to the atmosphere, is superior to any known mortar-making material.

It is sufficiently hydraulic to be classed as a very slow-setting hydraulic cement.

Concrete made from such a mortar will require from sixty to ninety days to become sufficiently hardened to bear submersion.

This quality of lime has been used extensively in Europe for many years in the making of concrete blocks for sea-walls and general submarine masonry, — notably in France during the past sixty years.

Beckwith states that the hydraulic limestone quarries of Tiel, France, have been worked for several centuries.

John Smeaton, C. E., of England, used an eminently hydraulic lime mortar in the construction of the Eddystone Lighthouse, in 1757.

There are tens of millions of tons of this class of hydraulic limestone in this country, that can be cheaply produced, and will be, whenever our engineers and architects may create a demand for it.

HYDRAULIC CEMENTS.

A limestone that, after calcination, is proven by analysis to contain thirty-eight to forty-two per cent of clay will produce an active setting hydraulic cement.

Upward of one hundred and forty million barrels of this class of cements has been produced and consumed in the United States since its first production, in 1818.

During the last ten years ending Jan. 1, 1894 the production was 61,894,878 barrels.

Fully ninety-five per cent of all the great engineering and architectural work of this country has been done with this class of American rock cements.

The failures to do excellent work will not aggregate one hundredth of one per cent.

Probably no country on the globe is more favored with such an abundance, and of such excellent quality, of natural cement rock, as is known to exist in a vast number of localities in this country.

In a few localities in France there are natural rock cement beds of first quality, but in England they occur very rarely.

In our classification of impure limestones of the United States we have defined the proportions of clay within certain narrow limits for the sake of a starting point, but the proportions of clay to lime varies in different localities, and the action of these ingredients is largely dependent on the proportions of the constituent parts of the clay, also when magnesia to a greater or less extent enters into the combination, all of which has an important bearing on the enduring qualities of a cement.

These and other important features will be discussed in future papers.

URIAH CUMMINGS.

A SECOND REPLY TO MR. TUCKER.

PHILADELPHIA, Nov. 19, 1894.

EDITOR OF THE BRICKBUILDER, Boston, Mass.:

Dear Sir: — We note in Mr. Tucker's reply to the writer's letter in last month's BRICKBUILDER that he does not give any data to defend his assertions that "The German Portland Cements are the finest in the world," and that the American Portlands "have a long road to travel before reaching the standard of excellence attained by our rivals across the water," but does admit, to use his own words, "that some American manufacturers can produce a cement equal, nay, superior, to the foreign article." This is a great admission for any one to make after using the terms he did in his former article, but he spoils all the good it did by insinuating that such cements are made for particular jobs and on special occasions, so necessitating the writer to again take up the subject, and, as further proof that there

TABLE No. 1.

GEO. S. WEBSTER, *Chief Engineer.* R. L. HUMPHREYS, *Inspector of Cement.*

BRAND.	FINENESS. NO. 50 SIEVE.	NO. OF SAMPLES.		NO. OF BRIQUETTS.		AVERAGE TENSILE STRENGTH IN LBS. PER SQUARE INCH.					
		COLLECTED.	REJECTED.	MOULDED.	BROKEN.	7 DAYS.	28 DAYS.	2 MOS.	3 MOS.	4 MOS.	6 MOS.
Bell, Belgium, ...	98.13	3	2	24	22	320	439				
Dagger, "	99.25	1		8	8	403	433	463			
Alsens, German, ...	99.38	2		16	16	435	490	603	615		
Dyckerhoff, "	99.52	33		264	226	446	526	551	561	574	647
Germania, "	100.00	1		8	8	388	476				
Mannheimer, "	99.42	52	3	416	340	370	434	460	502	524	555
Offenbach, "	99.65	6	3	48	44	303	408	419			432
Brooks, Shoobridge, English,	96.25	2		28	18	352	526				
Burham, "	95.58	55	5	420	361	360	445	493	511	540	591
Gostling, "	94.00	3	1	24	22	435	443	525	571		
Hilton, "	94.13	4	2	40	36	367	415	457			653
Dragon, American, . . .	99.75	1		8	8	347	408	545			
Egypt, " . . .	99.21	11	4	88	82	330	400	451		495	612
Whitaker's, " . . .	99.80	3		24	24	373	560	575		722	
Saylor's, " . . .	100.00	15		120	84	413	549		602		

are American brands equal to the German brands, we submit the following tests: —

TABLE No. 2.

The following are the principal brands of Portland Cement which have been tested: —

BRAND.		RESIDUE ON SIEVE.		TENSILE STRENGTH. NEAT.		TENSILE STRENGTH. THREE PARTS QUARTZ.	
		NO. 50	NO. 100	7 DAYS.	28 DAYS.	7 DAYS.	28 DAYS.
Germania,	German.	Trace.	6	550	675	180	235
Dyckerhoff,	"		6	740		210	
Porter,	"		8	500		115	
Schifferdecker,	"	Trace.	8	350	430	140	160
Alsens,	"	"	9	420		145	
Hanover,	"					120	166
Best German,	"		6	700		170	
White's,	English.	1.	24	492		108	
New Castle,	"	1.5	10	550	700	130	200
Giant,	American.		6	640	680	160	250
Atlas,	"	Trace.	8.5	650	675	175	175
Belfouse,	"	1.5	13	430	598	96	137
Whitaker,	"		2	790	880	230	350
Empire,	"	Trace.	12	800	920	120	170

Table No. 2 is from the report of the Engineer Department of the District of Columbia for the year 1893.

Table No. 3 shows tests made by Prof. F. P. Spaulding, of the Cornell University, as published in the *Engineering News* of Aug. 24, 1893. In connection with these tests Mr. Spaulding says: "The samples used in the tests are all of well-known brands in common use in this country, and were taken for this purpose because they were conveniently at hand and seemed to represent all grades."†

Now if Mr. Tucker has made tests the results of which would warrant the broad assertions that he has made, we would like to see them in the next issue of your paper. Certainly your readers are entitled to know upon what extent of investigation such assertions are based, as it is well known that the results of other engineers' tests have shown that Mr. Tucker's opinion of American Portland Cement — no matter how many other engineers in the country possess the same opinion — is erroneous.

Very truly yours, WM. G. HARTRANFT,
Vice-President Commercial Wood & Cement Company,
Philadelphia, Penn.

*For full account of all tests see Annual Report of the Director of Public Works, Philadelphia, 1893.
†For full report of tests see *Engineering News*, Aug. 24, 1893.

TABLE No. 3.

DESIGN OF SAMPLE.	KIND OF CEMENT.	PERCENTAGE PASSING THROUGH SIEVE. 2,500 MESHES PER SQ. IN.	6,400 MESHES PER SQ. IN.	32,400 MESHES PER SQ. IN.	TIME OF SETTING. IN MINUTES.	TENSILE STRENGTH IN LBS. PER SQ. IN. NEAT CEMENT. 1 WEEK.	4 WEEKS.	13 WEEKS.	26 WEEKS.	52 WEEKS.	TENSILE STRAIN IN LBS. PER SQ. IN. 1 CEMENT AND 3 SAND. 7 DAYS.	28 DAYS.	COLD WATER TEST. 50° & 60° F.	BOILING TEST.
A	English Portland.	91	77	62	25	221	312	460		620	58	117	Sound after 1 Year.	Sound.
B	" "	93	82	67	90	234	397	491		675	66	142	"	"
C	German "	98	88	67	240	332	491	627		720	80	122	"	"
D	" "	99	93	70	300	307	487	580		672	117	169	"	"
E	American "	96	86	66	185	315	487	523		720	155	212	"	"
F	" "	100	91	68	95	307	454	507		702	100	174	"	"
K	English "	95	84	58	20	442	502	535	551		106	188	Sound after 6 Mos.	"
L	German "	98	94	65	320	374	487	541	560		134	164	"	"
M	American "	99	96	70	90	352	439	521	556		101	159	"	"

Table No. 1 shows some of the leading brands of cement tested by the Survey Department of the city of Philadelphia during 1893 — samples collected from time to time as the work progressed.*

THE MASON CONTRACTOR.

A Department conducted in the interests of the Builder, and the Contractor for Brickwork.

CONTRACT AND CONTRACTOR.

AMONG the many features of the building business which are susceptible of improvement are the uncertain and inferred requirements from the builder in the execution of a contract under the present methods of competition. It is customary for a contractor to sign an agreement to erect a building according to certain specifications and drawings, to supply all material, and perform all work "*incident thereto*," whether mentioned in the specifications or shown on the drawings or not; the architect to be the sole judge as to what is *incident* to the completion of the building. Granting that in all cases the architect intends to be perfectly fair, the existence of such a condition in a contract makes the agreement unjust, as it places in the hands of one party the power to require an unknown quantity of labor or material, or both, from the other party. The architect may maintain with much force that certain things are incident to the completion of a building, and the contractor may maintain the reverse with equal force; and yet the contractor is expected to accept the decision of the architect as final.

The contractor is asked to accept as final an interpretation by the architect of his own specifications and drawings, which interpretation the architect was unable or unwilling to give the contractor when the specifications and drawings were submitted to him as the means for estimating the cost of the proposed work. In no other business does such a condition of affairs exist, where one party to an agreement agrees to do a certain thing for a certain sum of money, and at the same time gives to the other party the power to make such interpretation of the work incident thereto as he sees fit, after the cost has been based upon certain definite descriptions and certain definite drawings. The bone of contention lies in the fact that there is opportunity for such an interpretation of the specifications and drawings as may subsequently force the contractor to do more work than was demanded by the interpretation given the specifications and drawings at the time they were submitted for estimate. While we should work for the complete establishment of the principle that, if any portion of work *cannot be definitely described or shown at the time estimates are asked for*, then it should be left entirely out of the calculations until it *can* be so described or shown, it is evident that until this reform is secured there is need for the establishment of some method whereby the contractor may be assured greater equity in the premises. When there is necessity for interpreting the drawings or specifications, the contractor should not be forced to accept any interpretation without appeal. One way in which this inequality might be overcome is through the establishment of boards of reference to which questions at issue may be submitted. A permanent board of reference, composed of three men who are familiar with building operations, could be created by the architects and builders in any city. One member could be appointed by the architects, one by the builders, and a third appointed by the two thus chosen. This board could be appointed at the beginning of each year, and should be accessible at any time for the settlement of disputes under building contracts. Regular fees could be established, and builders and architects would thus have a fair means of adjustment of all questions at issue which they are willing to submit to arbitration.

Special boards of reference could be created for each contract by mutual agreement between the contractor and the owner, or his agent, the architect. Each, acting independently, should select one representative, and a third person should be selected by mutual agreement; the three thus selected to form a board of reference, their names and the object of their appointment to be incorporated into the contract before it is signed. By this means litigation would again be avoided, except as a last resort. These boards would not be active except in case of need, when the contractor and architect could not agree as to what might be justly considered incident to the completion of a building. Many complications which now arise would be avoided through the existence of fair and honorable means for obtaining unbiased opinion upon all contingencies that might arise during the execution of a contract. The appointment of such boards would require comparatively little effort, and the result would greatly simplify and improve the conditions under which building contracts are executed. The existence of such means of settlement need not delay the progress of work, for it could be provided that the architect's interpretation could be carried out and the adjustment of amount of additional allowance to or deduction from the contract would then become the matter to be adjusted by the board.

The present custom of interpreting drawings and specifications is inherently unfair, notwithstanding the fact that many buildings are annually erected without serious difference between the contractor and the architect; the contractor is allowed no voice in the settlement of questions that are of vital pecuniary interest to him. Contractors have always submitted to a large amount of injustice in the demands made upon them, but there is no good reason why they should continue to do so.—*Bulletin of the National Association of Builders.*

GEOMETRICAL PATTERNS IN BRICKWORK.

I.

American Bond with Two Colors.

(*Continued from October.*)

ON Plate 86 we give ten more examples of geometrical work with stretchers. These are of the same general character as those given in the last number. Of course, the number of combinations is endless, but there is danger in departing too far from the simpler designs. The diamond motive is the most useful by all odds, as comparison of the three designs this month and the two given last month will show.

When Roman shape brick are used and laid so that the joints come in the middle of the bricks above and below, the same pattern will apply, but of course the effect will be to greatly flatten and elongate the designs. Again let us caution readers who are not accustomed to using these patterns to avoid strong contrasts. Some of the best effects are secured by sorting one lot of brick, and even then softening the effect by laying middle-shade bricks here and there so as to tone down the dark or light bricks.

VERY often a builder is in need of some circular ornament, such as a medallion, to fill a place in the spandrel between two arches. The terra-cotta companies are constantly being called upon to execute such work for the finest buildings, and their designers and modellers are extremely facile in this direction. This, for instance, was made by the New York Architectural Terra-Cotta Company, of 38 Park Row, New York City, for the American Theatre, New York. While the company might not duplicate this design, it can readily supply others equally satisfactory. In the preceding pages of this number will be found other details of terra-cotta work, panels, capitals, etc., and a number will be published in each issue. For a list of the leading terra-cotta companies, the reader is referred to the advertising pages in the front of the paper.

A TERRA-COTTA MANTEL.

THE above photographic reproduction shows an example of terra-cotta used for domestic interiors. This design is after the Colonial style, now so popular in modern American architecture. It was executed by the Glens Falls Brick and Terra-Cotta Co., of Glens Falls, N. Y. Mr. Chas. Scales, the secretary, will be glad to give estimates for this class of work.

A SUGGESTION FOR A MOULDED BRICK CORNICE.

OUR prospectus for the coming year will be printed in the December number.

THE MANUFACTURER.

A Department devoted to the Market Side of Clay Production.

ARCHITECTS AND BRICKMAKERS.

EDITOR OF THE BRICKBUILDER:

Sir, — The kindly effort you have shown in your endeavors to bring the brick manufacturer in closer touch with the architect, to teach the factor of clay that there is a market for products he would never have thought of had it not been for you, is, to say the least, commendable, and yet I doubt whether the brick manufacturer will either comprehend or appreciate your intentions. The maker of bricks, generally speaking, is not a brilliantly progressive creature. His chief ambition is to make those articles *demanded by the trade* He objects to innovations and dislikes making experiments; and yet he does experiment in an aimless way, which results in nothing practicable. His most important "discoveries" are the result of accident, as witness the so-called "Pompeian" and "rain-washed" bricks; instances which illustrate all too well how eager "the trade" is to take up with anything new, no matter what may be its merits.

On the other hand, "the trade," or really the architect, is constrained to purchase or specify only those products which are presented to him.

He may dream of broader textural effects and wider possibilities of color treatment, but his dreams are negatived by the impossibility of procuring the material he desires, for the simple reason that "the trade" has not before demanded it. It might be considered as a very true axiom of business generally, that it is difficult to purchase those things which are not made.

Taking up your suggestions regarding the "common" brick made one and one half inches wide, while they would be exceedingly difficult to make, I agree with your numerous architectural correspondents that they would add a charming diversity to brick construction, providing they were properly used and their limitations fully understood.

It is quite probable, however, that the ordinary architect would require them to be made with the same mathematical precision which literally "knocks the stuffing" out of most of the brick construction erected in this country.

It would be almost impossible to so produce them. Thank God! they would warp and twist so that they would have some individuality of their own, so that it would be necessary to allow them to possess a joint which should show some reason, some excuse, for their existence as the *complimental* part of a wall or structure.

As a matter of fact, in these later days — possibly since the invention of sandpaper — the idea seems to obtain that the seam or joint in brick construction should be hidden, concealed, eliminated as far as possible; that this is something to be ashamed of; that it is necessary to grind the edges of the bricks or color the mortar, so as to convey the idea that "in this particular wall there are no joints."

How absurd! how ridiculous this idea is! and yet how common. *The primal part or portion of every brick wall is, and must be, the cement or mortar, — the bricks are only complementary.*

It is perfectly feasible, and has been for ages, to build an entire structure of cement or mortar without the assistance of any other material, making it not only weather and climate proof, but architecturally beautiful as well. Can this be done with bricks alone?

The ancients understood brick structure, oh, so much better than we! and as we have to go back many centuries to arrive at the basis of mathematics, as we have to learn from antiquity the primal laws of form and color, — which mean architecture, — so have we to turn in retrospect to earlier ages to learn what brick architecture really means; to comprehend and understand that not only is the joint a part of the structure, an important part, an integral part, but that as a matter of fact the effect obtained in brick construction, artistically considered, is not so much dependent on the color of the bricks used as it is upon the wisdom shown in the definition of the *joints* and the honesty with which they are treated.

H. E. STREETER.

BOSTON, Oct. 30, 1894.

BRICK FOR FENCES.

BRICK is the only material for fences or walls that improves with age. Wood rots, or breaks, or the posts get loose and the fence looks "wobbly." Iron rusts. Both are a continual expense for painting, and must be rebuilt every few years. Stone is very expensive, and many varieties disintegrate badly. A brick wall can be so designed and built that it will improve year after year, be absolutely no expense after the building, and, last but not least, it is a new market for just so many brick.

LOCAL ADVERTISING

II.

A SERIES OF SUGGESTIONS FOR THE AVERAGE BRICKMAKER.

MANUFACTURERS of front brick or of a good quality common brick cannot help getting their brick into one or more handsome buildings. Photographs of such buildings are always appreciated by people in the town, and are of interest to those of neighboring places. A good photographic reproduction would be almost certain to find a place on walls of law, insurance, real-estate, and general business offices, if some care were taken in placing it. Such photographs would find a place where finely lithographed advertisements lacking local interest would not. Suppose the building in question is a church. A thousand heliotype prints on 11 x 14 paper, with your printed advertisement, and a metal eyelet to hang up by, would cost about $40. These would thoroughly cover your immediate territory and be a standing advertisement for a year, on an average. Wherever hung up, they would attract attention. When any person steps into a business office and for some reason has a moment or two to wait, the first impulse is to examine the nearest picture or lithograph or illustrated advertisement displayed upon the wall. With several attractive subjects, covering a variety of buildings, the wide-awake brickmaker for a couple hundred dollars can most thoroughly advertise his business locally.

BLACK HEADERS.

THERE is a rapidly increasing demand among architects for black headers, which, used alternately with red stretchers in Flemish bond, with broad white mortar joints, are all the rage. We heard not long ago of a brickmaker who had taken a contract to furnish more black headers than he had in stock. "Standing in" with the mason contractor, stock was quickly made, with a pot of black paint. Through careless superintendence, the job got through without getting spotted by the architect. The black headers were used to form a pattern on the plain wall surface. The paint was none too good, and rather hastily applied, and as a result the pattern has almost disappeared, except as the white mortar indicates a difference in the bond.

BRICK CORNICES.

THE Special Cornice number of THE BRICKBUILDER contains forty-five designs for brick cornices from seven to twenty-one courses high. It is a good thing for every brickmaker to have on hand. Price twenty-five cents.

TRADE NOTES.

Yard Equipment.

MESSRS. C. L. BIGLER & CO., brick manufacturers, Harrisburg, Pa., will probably enlarge their plant to three times its present capacity, requiring new machinery, kilns, and drying outfit.

WE are in receipt of a letter from the Standard Dry Kiln Company, Indianapolis, calling our attention to an article that has recently appeared in some of the journals respective of a dispute regarding control of patents of the Reliance Kiln. The Standard wish it known and distinctly understood that there is no dispute as regards these valuable patents; that they are wholly controlled by the Standard Company, and any question to the contrary originated from a desire to injure the Standard Company. We congratulate them on the fact of having taken active measures to counteract any such reports.

Clay Materials.

THE NEW BRITAIN ARCHITECTURAL TERRA-COTTA COMPANY is producing some very handsome designs for the Science Building at the University in Burlington, Vt. This is one of the largest contracts the company has secured in New England, and we trust the late fire at their works will not seriously hamper the delivery of the material.

THE turn over of the manufacturing plant and real estate of the Anderson Pressed Brick Company should be productive of the result of placing that company on a good financial basis, and enable them to produce their bricks at prices that will make them available to the market and show a profit to the company. We understand the property has been purchased by Mr. Worman D. Fraser, for $160,000, on behalf of the mortgagees, who will carry on the works.

THE death of Mr. William H. Pfingsthorn, secretary and treasurer of the American Enamelled Brick and Tile Company, Mohawk Building, New York, which at the time of Mr. Pfingsthorn's death was engaged in equipping a new plant at South River, N. J., will in no way interfere with the plans of the company, who are now pushing to completion their new works and expect to place their enamelled brick upon the market not later than Dec. 1.

THE SOMERSET & JOHNSBURG COMPANY, Boston, are supplying the enamel brick in the tunnel of the Franklin Street subway at Allston, Mass. These very fine specimens of good enamel have called forth some very favorable comments. The general design of laying of the different colors is worthy of mention, since it seems to set off each by contrast. Three courses of light-brown enamel brick, two courses of white, one course of brown, twenty courses of white, and two courses of brown as capping. The effect is very pleasing, and in the opinion of most a great deal more desirable than that of the plain white enamel brick used alone.

BIRMINGHAM, ALA. — Mayberry & Watson Company, corner 20th Street and Powell Avenue, press brick, fire brick, and clay, terra-cotta, etc.; new firm.

Miscellaneous.

THE new "Castle Square" Theatre, Boston, has been equipped with thirty Guibert swinging hose racks.

THE STURTEVANT MILL COMPANY, 70 Kilby Street, Boston, report the largest shipment of their well-known Rock Emery Mill Stones ever made to any one party in the South. The invoice referred to was two thousand Rock Emery Mill Stones, assorted sizes, to J. B. Speed & Co., Louisville, Ky. The company further report good business in their line in the South and East, with but very little activity in the West. The numerous inquiries they are receiving for goods for the spring trade in that quarter would promise for much improvement early in the new year.

ST. LOUIS, MO. — The Wimple Terra-Cotta Company, Mauch & Pierce, have given out contract for the erection of a new $4,500 factory building.

SPENCER, MASS. — William A. Barr & Sons, brick manufacturers, are erecting a new factory building on Wall Street.